The Marine Laboratory
Institute Of Marine Science
UNIVERSITY OF MIAMI

SIXTH INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida. November 15, 1961

held under the auspices of the

INTERNATIONAL
OCEANOGRAPHIC
FOUNDATION

and the

GULF AND CARIBBEAN FISHERIES INSTITUTE

MIAMI 49, FLORIDA

PROCEEDINGS

of the

SIXTH INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida

November 15, 1961

under the auspices of the

INTERNATIONAL
OCEANOGRAPHIC
FOUNDATION

and the

GULF AND CARIBBEAN FISHERIES INSTITUTE

MORNING SESSION
Chairman: Dr. Donald P. de Sylva

AFTERNOON SESSION
Chairman: Dr. F. G. Walton Smith

THE INSTITUTE OF MARINE SCIENCE
University of Miami
Virginia Key
Miami 49, Florida

INTRODUCTION

Donald P. de Sylva

Institute of Marine Science, University of Miami

It is with sincere appreciation that we welcome you to the Sixth Annual Meeting of the International Game Fish Conference. Since its inception in 1956, we have attempted to bring marine scientists, who study the sea in all its aspects, and non-professionals, such as anglers, yachtsmen, charterboatmen, and skin divers, together on an informal basis to present topics of mutual interests and to discuss ideas which will stimulate further studies on the part of both groups. Although the underlying theme of the past conferences has implied the avenues of cooperation between the professional and non-professional marine scientist, the present meeting will stress the potentials of such mutual understanding. It is hoped that the scientist and non-professional will be able to work together toward the solution of goals in the study of the oceans, and that the talks and subsequent discussions will illustrate some of the methods of cooperation, which in turn will stimulate future cooperative research.

An outgrowth of this meeting has been the establishment of the Cooperative Research Committee of the International Oceanographic Foundation. The aims and functions of this Committee, though in existence informally for many years through the Foundation, are to assist cooperation between the scientist and non-professional in their search for knowledge of the sea. Acting as a clearing house, the Committee hopes to be of service to anyone wishing its assistance. An outline of the scope of the Committee and plans for future cooperated research is appended.

Appended also is the program of the Reef-fish Symposium, sponsored on November 14th by the Gulf and Caribbean Fisheries Institute and the International Game Fish Conference. The Symposium was a tremendous success and was well received by both the participants and audience. However, since the talks presented by most of the speakers contained much original research which will eventually be published and more fully documented elsewhere, it was felt that the proceedings of the Symposium should not be reproduced here.

It is our hope that the aims of both the Conference and the Committee will continue to bring together groups such as yourselves in the years to come.

HOW CAN ANGLERS AND SCIENTISTS COOPERATE? AN ANGLER'S VIEWPOINT*

Presented by

Nelson Benedict

NEWARK STAR-LEDGER
Newark, New Jersey

at the Sixth

INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida

November 15, 1961

---

* Manuscript not received for inclusion in this report

SOME MARINE SPORT FISHERY PROBLEMS

Presented by

Richard H. Stroud

SPORT FISHING INSTITUTE, INC.
Washington, D. C.

at the Sixth

INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida

November 15, 1961

SOME MARINE SPORT FISHERY PROBLEMS

By Richard H. Stroud

Executive Vice President
Sport Fishing Institute, Washington, D. C.

Mr. Chairman, Sport Fishing Institute is pleased to participate in this important conference. Marine game fish matters are no stranger to SFI, which was organized a dozen years ago to concern itself with all sport fishery matters of the U. S. From the outset, SFI has been a pioneer force in developing national recognition of the significance of the marine sport fisheries and in stimulating programs of basic research on marine game fishes. SFI's Director of Research, Bob Jenkins, will discuss that activity briefly here today.

Marine fishery resources limited. From time immemorial, Man--including anglers, commercial fishermen, landlubbers, and marine biologists, alike--seems to have regarded ocean fishery resources as inexhaustible. At least, until very recently. Perhaps the first serious formal challenge to this cornucopian concept of the seas was delivered by two fishery scientists of the U. S. Fish & Wildlife Service (Bureau of Commercial Fisheries) at the recent UN FAO Conference on Fish Nutrition (in Washington, D. C.). They calculated roughly that the world's seas contain about 560 billion pounds of bony fishes all told, of which about half--280 billion pounds--might ultimately become available for use by Man. They estimated present world harvest at about 66 billion pounds, or about one-fourth of the available supply (Graham and Edwards, 1961).

The significance lies not in the precision of the estimates but in the fact that it is possible to show that yield is not unlimited, and that judgments of the upper limits of supply and yield are possible. These estimates are equivalent to a total supply of bony fishes equal to about 6 pounds per acre of total ocean area, a maximum potential yield about 3 pounds per acre, and a current yield somewhat less than 1 pound per acre. This is comparable to the average yield per acre in the Great Lakes. It is considerably less than the yield (over 9 pounds) per acre) of fish in Lake Erie, the most productive of those waters.

Conflicting uses of fishery resources. It is small wonder, therefore, that anglers are coming into conflict from time to time with commercial fishermen over use of the marine fishery resources, particularly in close-in coastal waters, bays, and estuaries. Heads-in-sand attitudes, wishful thinking will not solve these problems. On the contrary, the rapid proliferation in numbers of marine anglers--nearly 7 per cent annually--will probably aggravate rather than diminish them. In 1960, there were an estimated 6.3 million anglers who fished regularly in salt water. There were also estimated to be some 3.5 million more who fished occasionally in salt water. Close to 10 million in all!

Already, some states have acted to designate some marine species as game fish--snook in Florida, striped bass in California, for example. There are others and the list seems sure to grow in the next few decades. A national survey of salt-water sport fishing, supplement to the 1960 National Survey of Fishing and Hunting, revealed a national sport catch of about 633 million fish. If these averaged somewhat under a pound apiece, they were equivalent to about one-fourth of the commercial harvest of food fishes in the U. S. coastal waters. For some jointly exploited species, in some coastal areas, it is known that sport fishing harvest already at least equals the commercial harvest. It is known, too, that sport fish harvest alone may be sufficiently great to utilize the entire annual recruitment of a species (Poole, 1961).

Sport fishing effort on coastal marine waters will probably become double the current effort by 1976. It may well become quadruple by the last decade of the current century. It seems apparent, for an increasing number of species, that marine bony fish resources are not in sufficient supply for indefinitely carefree joint exploitation by both sport and commercial interests. When harvests are high--and approach or exceed recruitment--overfishing becomes possible and may threaten species abundance. Biological research can determine when rate of recruitment and rates of harvest approach one another. Administrators and legislators, responsive to the best interests of the public, must make the necessary and unavoidable decisions regarding the wisest use of the marine fishery resource.

The matter of "wise use." A prominent marine fishery scientist has suggested to me in a recent personal communication that only those peoples who discard the skins of fishes but utilize their flesh for food are true fish conservationists and that those other peoples who discard the meat and save the skins (as mounted trophies) are not. He was of course suggesting that sport fishing is a form of waste of scarce protein in a very hungry world. There is some obvious waste in the practice by some anglers, for example, of catching magnificent game fishes like the marlins only to hang them in the sun to rot after taking a few snapshots. There is far greater--though less noticeable--waste in the failure of some commercial men to use savings gear which would permit the escape of young fishes of a number of species for the greater bounty of the future.

In our envied, sophisticated society, "wise use" does not necessarily imply exclusive use of fish as food. It is trite but nonetheless true to say that "man does not live by bread along." This philosophy finds its greatest expression and realization, of course, in a modern democratic society such as ours. As a point of fact, our chief source of protein is beef, not fish, and monies now spent to

purchase commercially-caught fishes as food can as easily be spent on other cheap meats--and are, increasingly. Whatever vital nutritional contribution is made by fish to diet is readily suppliable from the catches of sport fishermen. Including fresh water, these are already equivalent to half or more of the total U. S. commercial catch of food fishes. Contributions to the economy from purchase of goods and services utilized out fishing on marine waters already amounts to some $626 million at retail. This is about half the ultimate value of U. S.-caught commercial food fishes, also at retail. It will equal it by 1976 and double it or more by 1990.

New fishery management capabilities possible. Many marine fishery biologists have neglected ecology and been content to become historians, collecting and charting statistics of catch. They have assumed--until very recently--that catch regulation is the only promising approach to the matter of managing marine fishery resources. One of the nation's best-known marine fishery administrators told me as recently as two years ago, for example, that "once you know catch, you know everything!" I could scarcely believe my ears.

Freshwater fishery biologists abandoned this view more than twenty years ago. By the late thirties, they had begun to study the fish populations themselves in addition to collecting statistics of catch. It was not long until they discovered that catch alone is a very imperfect mirror of population structure and dynamics. This realization led directly to year-round fishing for warmwater sport fishes and an eventual doubling of fishing opportunity in inland waters, without harm to future supply.

There are many possibilities for managing fish populations beyond regulating catch--in coastal marine as well as inland waters. For example, the Japanese have known much for centuries about attracting marine organisms to artifical points of concentration. The extent of their activity along this line was revealed in this country only last year through a Tokyo Embassy Dispatch. We have been fortunate to learn some of what they have known, independently (since World War I), through a happy combination of a lot of accident and a little research. Very limited research on artificial fishing reefs in marine waters has occurred here in the past decade. In contrast, use of artificial reefs or fish shelters had already become a sophisticated tool of freshwater fishery management by the early thirties....

Suffice it to say, now, that marine sport fishery interests in 12 of our coastal states recognize that previously unsuspected capabilities to manage coastal marine fish resources exist, are needed, and are in actual use to a limited extent. As the number of anglers and the amount of fishing effort grow, these management capabilities must be extended and multiplied many-fold and developed along new lines possibly unsuspected at the moment.

Broad-scale research programs needed. With increased knowledge of the detailed life histories and ecology of the fishes, their behavior and population dynamics, together with intimate knowledge of their environments, a multiplicity of new management capabilities seems almost certain to unfold. Many examples from other fields of science give us confidence on this score, and it has already been borne out to an encouraging degree in the freshwater fisheries. What is needed, we believe, is a broad-scale program of basic and applied research. The latter is dependent upon the former, and in turn produces the fish management tools needed to assure maximum sustained yields with which to supply increasing fishing demand.

As many folk know, a start has been made toward developing the needed continuing basic research program, in the establishment of the new marine game fish research program within the Bureau of Sport Fisheries and Wildlife, U. S. Fish and Wildlife Service. What many folk do not know, however, is that the specific action to set up this program was conceived and initiated by the Sport Fishing Institute. It could not have succeeded without the sponsorship of Congressman Alton C. Lennon of North Carolina, who introduced it and guided it through the House. Washington's Senator Warren G. Magnuson gave it vital support in the Senate. The national program which is being set up has a $2.7 million annual authorization. However, the appropriations so far have been only a small fraction of this amount. We are hopeful of a substantial increase in the appropriation next year. It will require wide, active support.

There is also a very limited program of applied research, experimental management, and development under way at the state level (where it should be, in our view), financed except in two states principally by a share of the D-J excise taxes from the sale of fishing tackle. Nationally, nearly 25 per cent of the excise taxes available to the coastal states are spent on marine projects. This is only a little under the proportion of saltwater anglers among all anglers in those states, so it seems fairly reasonable. What is needed here, again, is a many-fold increase in the amount of funds available for marine work. Obviously, most of it must come from new sources.

Saltwater license would provide needed funds. Only two states now have substantial marine sport fishery programs. These are California and Texas. It is significant that these same states are also the only ones having saltwater fishing licenses with extensive coverage of resident anglers. Alabama and Louisiana have token licensing coverage with correspondingly token revenues. As we see it, at this point, adequate financing both of basic research at the federal level and of applied research and development at the state level is a major stumbling

block to progress in the marine sport fisheries. Coupled with this is the need for adequate representation of sport fishery interests on regional associations of state marine fishery agencies that deal with jurisdictional matters. Licensing of saltwater anglers would go far toward solving these problems.

Improved financial support for basic research will come principally through increased Congressional appropriations for the purpose. Improved financial support for state programs of applied research and development can probably come satisfactorily only through application of the principle of licensing, as long established in all the states for financing inland fisheries work, and now well established in two coastal states for marine sport fisheries work. The license is purely and simply a fund-raising device, the best in sight, and a proven one at that.

No other practical means of raising substantial funds on a continuing basis for such purposes has been devised to date. For this reason Sport Fishing Institute endorses this approach. Experience with inland fishing licenses shows that an annual state fee of about $3.00 is needed to start. It also shows that administration, information-education, and law enforcement collectively would require about 25 per cent of the funds in the early program stages, leaving 75 per cent for development and applied research. It shows that the funds can be safeguarded against diversion by designing politicians to non-related purposes through deposit in earmarked funds (all states have them). It shows that licensing is acceptable and saleable to the vast majority of anglers if a budgeted program is presented and if there is a policy-making body or commission representing the anglers to oversee use of the funds (all states have them, usually made up of 5 or 7 members on staggered terms).

Such a set-up would yield, collectively, over $18 million annually at present--an average of about $800,000 per state. This amount of money would provide about $600,000 for development and applied research with about $200,000 for necessary administration, education, and law enforcement, combined. Initially, much development work could be undertaken to great advantage, as well as experimental management projects. With such a program, great benefit would flow to saltwater anglers.

Reciprocity privileges desirable. In one respect, a great improvement over inland licensing could and should be achieved at the outset in the marine field. The principle of reciprocity should be built in so that a license purchased in one state would be valid in waters of the state sharing a common border. SFI is opposed to a federal license, as are all the states. Nevertheless, one way to bring this about might be through federal legislation patterned

after the federal boating act. Such an approach would establish a federal license covering the coastal waters of those states that do not have a state license carrying reciprocity privileges with its neighbors.

Thank you.

LITERATURE CITED

Graham, Herbert W. and R. L. Edwards.
1961. The world biomass of marine fishes. Int. Conf. on Fish in Nutrition, UN FAO. Unpub. Ms. (Sep.).

Poole, John C.
1961. Age and growth of the fluke on Great South Bay and their significance to the sport fishery. N. Y. Fish & Game Jour., 8(1):1-18 (Jan.).

MARINE FISHERY RESEARCH SPONSORED BY SPORT FISHING INSTITUTE

Presented by

Robert M. Jenkins

SPORT FISHING INSTITUTE, INC.
Washington, D. C.

at the Sixth

INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida

November 15, 1961

MARINE FISHERY RESEARCH
SPONSORED BY SPORT FISHING INSTITUTE

by Robert M. Jenkins

Assistant Executive Vice President
Sport Fishing Institute, Washington, D. C.

Dr. de Sylva, fellow fishery biologists, dedicated marine anglers, and guests: Let me begin by reviewing the purposes and program of the Sport Fishing Institute -- the only national non-governmental agency devoted exclusively to the conservation of sport fishes, freshwater and saltwater alike.

The Institute was formed twelve years ago by a group of farsighted fishing tackle manufacturers to help improve sport fishing. It is presently primarily supported by over 200 manufacturers of products (tackle and accessories, outboard motors, boats, trailers, sporting goods) used directly or indirectly by anglers. In addition, many individuals contribute as subscribing members.

The founding fathers of the Institute viewed the impressive progress evident in other fields, such as agriculture and medicine, resulting from fact-finding, public education, and rising professional standards, and reasoned that progress in fish conservation is also dependent on these same factors. Therefore, SFI, operates under a three-point program: (1) research in fishery biology, (2) fish conservation education, and (3) professional service to official agencies and key citizen groups.

Our concern this morning is with the research portion of that program. Since 1950, in addition to staff research activities, about $200,000 -- in the form of fellowships and cash or equipment grants -- have been made available by SFI (with a minimum of red tape) to qualified fishery reseachers in 40 colleges, universities, state agencies and other organizations, for specific fishery studies.

This year, research grants and activities constitute 30 per cent of the Institute's budget, including grants to 11 colleges and universities. Our goal is to increase the present research grant effort five-fold, as the program grows, through increased investment in the Institute by the sport fishing industry and by conservation-minded anglers.

Research on marine fishery problems makes up nearly 40 per cent of our grant budget this year. This may appear disproportionately high when one considers the many freshwater problems needing attention, and in view of the fact that only 17 per cent of all sport fishing is presently done in salt water. However, it has been predicted that

saltwater angler will double in 15 years and increase by 4½ times in the next 40 years. By the year 2000, at least 30 million people will probably be fishing regularly in the briny, compared to 6.3 million now.

In addition, marine sport fishery research has been sadly neglected by state and federal conservation agencies, with a few notable exceptions. It has been a "depressed area" in the over-all fishery field, which is only now beginning to show signs of badly needed vigor in keeping with its importance. The Institute attempts to use its research funds as "pump primers" to focus attention on particular areas that are not receiving adequate study, and which may inspire cognizant agency administrators to set up programs covering these areas. Therefore, this is what the Institute is attempting to do in the marine field, but with a very small budget in comparison with most granting agencies.

As a hopeful sign of the times at the federal level, the National Science Foundation is greatly increasing its grants directly concerned with marine fishes, according to data furnished me by Dr. J. Frances Allen (Systematic Biology Program Assistant Director). In fiscal 1959, NSF fishery research grants totalled $256,000. Fifty-two per cent of this amount was devoted to marine fishes. Last year, such grants were more than doubled (to $535,600) and the proportion directed at marine fishes increased to 68 per cent!

Many of you here are quite familiar with this excellent grant program. A quick scanning of the list of those scientists receiving fishery grants yielded the following familiar names: de Sylva, Randall, Gordon, Robins, Suttkus, Hubbs, Darnell, Fahy, Pickford, Raney, Mansueti, Myers, Aron, Gibbs. It is probable that a similar upward trend in grants bearing on marine fishes is also occurring in the appropriate branches of the National Institutes of Health, Office of Naval Research, and Atomic Energy Commission.

A new, though limited, source of grant monies which may appear is the recently-instituted marine research program of the Bureau of Sport Fisheries and Wildlife in the Department of the Interior. Things are definitely on the upswing in the marine sport fishery research field.

Current SFI grants. The current saltwater grants of the Sport Fishing Institute cover problems quite varied in nature and rather widespread geographically. One is on the fishes and sport fishery in famous Biscayne Bay -- just a few steps from here. The study is being conducted by Richard Wade under the direction of Dr. C. Richard Robins of the University of Miami, Institute of Marine Science. It involves censusing of angler catches on bridges over the Bay, and recording of measurements, gonad condition, and stomach contents. To date, 26 of the 74 species

occurring in the Bay have been checked in hook and line catches.

In addition, periodic observations from a helicopter aid in determining fisherman activity and schooling behavior of fishes. The long-range objective is to assist in the determination of effects of pollution, dredging and bulkheading, trawling and boating on fish population dynamics within the Bay.

Over on the Florida Gulf Coast, an SFI grant has been made to Dr. Charles Cole at the University of South Florida (Tampa) to study the effects of bayshore modifications on the fishes of Tampa Bay. Pete is conducting field sampling to determine distribution in relation to pollution, past dredging and filling, and in areas which are scheduled for modification to obtain a "before-and-after" picture.

Life history studies of marlin, dolphin, cobia and bluefish are being pursued by students of Dr. W. W. Hassler at the North Carolina State College, Hatteras Marine Station under SFI sponsorship. As in the Biscayne Bay study, catches of anglers are utilized to obtain data. This economic method of collection, although selective, has been utilized for many years by freshwater biologists, and is being increasingly resorted to in marine work.

An Institute grant has been made for graduate study under Mr. Frank Mather at Woods Hole Oceanographic Institution, in conjunction with their exploratory high seas long-line cruises. Objectives are to determine seasonal distribution and life history of tunas, marlins and amberjack off the Atlantic Coast.

Studies on sex ratios in young, downstream migrant steelhead trout are under way at the University of Washington (Seattle) with SFI backing. A graduate student, under Dr. Alexander M. Dollar, is working on sex determination in this famous anadromous species by clipping the fin tip from small migrants, and by employing the cell culture technique to identify sex by chromosome differences noted. Ultimate objectives are to find ideal sex ratio, effects on sex ratio of grading fingerlings during hatchery releases, and differential vulnerability of sexes to predation.

The aquatic information retrieval system being developed by Dr. Saul B. Saila at Rhode Island University was supported in its early stages by SFI. Automatic data-processing equipment is being put to work in the tedious task of literature searching. Much work has been required in setting up an appropriate indexing scheme. The system is expected to be in operation soon, with the aid of a recent sizeable grant from the U. S. Bureau of Commercial Fisheries.

Lastly, the Sport Fishing Institute makes funds available to the American Fisheries Society for help in publishing lengthy (over 15 pages) meritorious papers in its quarterly journal.

During the past ten years, SFI has made a number of grants with which some of you here are well acquainted, I'm sure. To mention a few -- the first coordinated study of the striped bass on the Atlantic Coast, led by Dr. Ed Raney, was made possible in large measure by the meristic studies at Cornell, fostered by SFI funds. Dr. Bill Lund's doctoral work at Cornell on bluefish was SFI-sponsored. Dr. Don de Sylva's studies on Delaware Bay fishes was Institute-backed. Aid has been extended in surf-fish food studies at Long Beach State College, in offshore sampling by Virginia Institute of Marine Science biologists, and in the marlin studies of Dr. Jim Morrow. In addition, many of the studies conducted in inland waters undoubtedly have applications in coastal waters (examples: quantitative population sampling, Atlantic salmon, pesticide and other pollutant effects).

The members of the Institute take pride in their contribution toward advancing the frontiers of knowledge to the nation's fishery resources. The use of SFI research grants as pump-primers is increasingly effective. Progress is being made in answering some of the perplexing questions confronting all of us.

A recent editorial in SCIENCE (weekly publication of the AAAS) praised the relatively small, non-profit scientific and educational organizations such as SFI and the International Oceanographic Foundation for giving added impetus and direction to the huge foundation and governmental granting agencies, and in shoring up research in the less-appreciated fields. If it were not for organizations such as SFI and the IOF, the fishery field might be severly trampled in the general rush to do more and more research in the physical and medical sciences. SFI grants focus the attention of administrators of universities, research institutions, and governmental agencies on acute fishery problem areas, stir their interest, and in many cases prompt additional expenditure of funds and necessary equipment under their control. The result is better balance and a fairer share of the total effort directed toward obtaining facts, techniques and methods needed to assure an abundance of sport fishing in the future.

NOTES ON TAGGING SALT WATER FISHES ALONG THE SOUTHWEST COAST OF FLORIDA

Presented by

Robert F. Hutton, Robert M. Ingle and Robert W. Topp

FLORIDA STATE BOARD OF CONSERVATION
Tallahassee, Florida

at the Sixth

INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida

November 15, 1961

NOTES ON TAGGING SALT WATER FISHES ALONG THE SOUTHWEST COAST OF FLORIDA[1]

by Robert F. Hutton, Robert M. Ingle and Robert W. Topp

FLORIDA STATE BOARD OF CONSERVATION
Tallahassee, Florida

Introduction

Starting in December 1960 the Jos. Schlitz Brewing Company in cooperation with the Florida State Board of Conservation and the Florida Game and Fresh Water Fish Commission sponsored a fish-tagging program in the form of a "fishing contest". The Schlitz Company was mainly interested in the "contest" from the promotional aspect for the sale of their product, but they were also interested in the research value to the State fisheries.

Supervision of the tagging of salt-water species was handled by the Conservation Department. The Game and Fresh Water Fish Commission was in charge of tagging fresh-water species. The Conservation Department entered into the program with the idea that the "contest" would benefit not only the tourist trade of the State but the fisheries research programs as well. When the Conservation Department decided to enter the program there was relatively little time available before actual tagging was to start. With this in mind, it was readily recognized that time did not permit detailed plans to be formulated and that the first year's work would be that of a pilot program with relatively few conclusions reached. Consequently the salt-water tagging program was designed primarily to study movements of fishes and if possible to obtain some information on fishing mortality, growth and efficiency of tags used. Certain deficiencies in the program were anticipated and are dealt with later in the paper. Long-range objectives are to assess the salt-water fisheries with respect to migration, abundance, mortality (natural and fishing) and growth for certain of the more valuable species.

Although the first year's work was in the nature of a pilot program, available evidence allows us to make certain tentative conclusions. Also, the results of this tagging program substantiates the validity of certain conclusions drawn from other tagging programs in the State. The purpose of this paper is to report the results to date (October 1, 1961) of the 1960-61 fish-tagging program conducted in Zone I along the southwest coast of Florida. Reports on the other three Zones will be presented elsewhere. Since much of our data is too voluminous to include here, our original records are on file for ready reference at the State Marine Laboratory, St. Petersburg, and at the Conservation Department main office, Tallahassee.

---

[1] Manuscript received December 8, 1961.

Methods and Materials

The State was arbitrarily divided into four "zones". The "zones" for salt water species were as follows:

Zone I. Northern Hernando County Line to Everglades City.

Zone II. Everglades City to the northern Indian River County Line.

Zone III. West Coast: Northern Hernando County Line to the Wacasassa River.

East Coast: Northern Indian River County Line to the northern Flagler County Line.

Zone IV. West Coast: Wacasassa River to the western Escambia County Line.

East Coast: Flagler County Line to the northern Nassau County Line.

Tagging of salt-water species began in Zone I on December 2, 1960, and stopped in Zone IV on May 5, 1961. More than 3000 individuals including more than 20 species were tagged by Messrs. Joseph Humphreys, Howard Foulk, Victor Springer, Andrew McErlean and Cassius Peddie. A total of 1001 tagged-fishes were released in Zone I by January 4, 1961. At least 13 species were represented in varying numbers, depending upon their availability and adaptability to the tagging program.

During the period of the contest (January 1 to March 31, 1961, in Zone I) the Schlitz Company was to redeem all salt-water tagged-fishes returned for values ranging from a minimum of $25 to a possible maximum of $10,000. The value of each tag was known only to the Schlitz officials until the fish was recaptured and turned in to the officials. A reward of $25 was paid for each tagged fish returned prior to January 1, 1961. Tagged fishes returned after the end of the contest (March 31, 1961, in Zone 1), and through December 31, 1962, would be redeemed by the same Company at $3 each. The Schlitz Company decided that the first tagged fish caught after midnight December 31, 1960, and verified through a Schlitz wholesale dealer would have a bonus value of $1000.

To be eligible for a monetary reward all tagged fishes caught during the contest had to be returned with the tag intact. The following information for all returned tagged-fishes was included on a Fishing Contest Release Form:

Date of catch:
Fish caught by:
Florida address:
Exact location where fish was caught:
Length to 1/2":
Tag No.:
Value:

Each contestant receiving a reward was required to sign the Release Form acknowledging the accuracy of the information and that he had complied with all the rules of the contest.

Probably more publicity was given to this tagging program than any other fish-tagging program ever conducted. In Zone I a dinner and press conference was held in Tampa before the official opening of the contest. The various new media, including outdoor and fishing editors of newspaper, radio and television, were invited. At this conference details of the contest were reported. Publicity for the contest was handled by the public relations firm, Barkin, Herman and Associates, Milwaukee, Wisconsin. The contest including all four Zones previously mentioned, was presented as the "$500,000. Florida Fishing Contest". It was open to tourists and residents alike. Full page advertisements of the contest were carried in newspapers throughout the country. Much additional publicity was given by the various news media.

Fishes used for tagging were caught in gill nets, cast nets or on hook and line by commercial fishermen or on hook and line by sport fishermen. Only fishes that appeared in a healthy condition were tagged and released. In most cases, fishes were released in areas of heavy sport fishing activity. Fishes that were released in areas other than where originally caught were transported in a 250-gallon recirculating water trailer. In some cases, fishes were held overnight in bait tanks or in a portable floating fish cage (2' x 4' x 4') made of hardware cloth. If the fishes held in captivity overnight appeared healthy, they were tagged and released.

Two types of tags were used. In Zone I all weakfish (Cynoscion nebulosus) were marked with yellow internal plastic streamer "anchor" tags (see Moffett, 1961). Other species were tagged with red Petersen disk tags (18 mm. dia.) consisting of two plastic disks, secured in place, one on each side of the back just under the anterior part of the dorsal fin, by a nickel pin that passed through the fish. Plates 1 and 2 show the types of tags used and the legend and type of identification serial number used.

Plate 1. Petersen Tag.

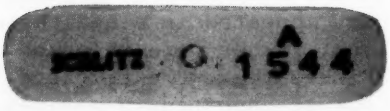

Plate 2. Face of Internal Streamer Tag

For recording purposes the "A" on each tag was used to differentiate tags used by the Conservation Department from those used by the Game and Fresh Water Fish Commission.

Measurements of fishes were in millimeters after placing the anterior end of the fish (not necessarily the tip of the snout) against the edge of a standard fish-measuring board. Standard length measurements were made to the base of the caudal fin (i. e., posterior edge of hypural plate). For species having truncate tails such as red drum and seatrout, total lengths were measured to the center of the posterior edge of the tail. Total length measurements for species such as mullet, having caudal fin lobes of approximately equal length, were made along the horizontal line to the intersection of a line drawn from the tip of the dorsal lobe to the tip of the ventral lobe. For specimens having unequal caudal fin lobes, measurements were taken on a horizontal line starting at the anterior end to the intersection of a perpendicular line drawn to the posterior end of the longer caudal fin lobe. In most cases fishes were frozen prior to being returned to the State Laboratory for final measurements.

Results by Species

SPOTTED SEATROUT, Cynoscion nebulosus (Cuvier):

A total of 513 spotted seatrout were tagged in Zone I from December 5, 1960, through January 4, 1961. Tagged fish were returned from December 24, 1960 through August 17, 1961. The greatest distance traveled was 120 miles by a fish released at John's Pass in Pinellas County on December 7, 1960 and recovered at Steinhatchee in Taylor County on June 29, 1961. The distance was traveled in 205 days with an average speed of 0.59 miles per day. Little tendency was shown for the movement of long distances. 80.7% of the recovered seatrout were captured less than five miles from the point of release. 98.2% were captured less than 20 miles from the point of release. The numbers of fish tagged and recaptured by county are listed in Table I.

Of the 513 seatrout tagged in Zone I, 119 were returned by August 17, 1961, with a recovery rate of 23.2%. Three specimens were returned on January 1, 1961. Only one fish was returned within ten days of release. Table II and Figure 1 show the returns by 30-day periods. The longest period of time a fish was free was 243 days. It was caught less than five miles from where it was released.

Many specimens showed a length shrinkage and others showed a length increment. Length shrinkage and other factors influencing length measurements will be discussed later. Table III lists the ten specimens showing the greatest amount of length increment (mm.).

TABLE I.

NUMBERS OF SEATROUT RETURNED BY COUNTY.

County	Number Tagged	Number Recaptured	Percentage
Hernando	41	4	9.8%
Pasco	15	1	6.7%
Pinellas	178	26	14.6%
Hillsborough	2	0	0.0%
Manatee	48	16	33.3%
Sarasota	138	36	26.1%
Charlotte	0	0	0.0%
Lee	86	36	41.9%
Collier	5	0	0.0%
Total	513	119	23.2%

TABLE II.

NUMBERS OF SEATROUT RETURNED BY 30-DAY PERIODS.

Days	Number Recaptured	Percentage Recaptured	Log_{10} Recaptures (see Figure 1)
1-30	42	35.3%	1.623
31-60	38	31.9%	1.580
61-90	22	18.5%	1.342
91-120	7	5.9%	.845
121-150	4	3.4%	.602
151-180	1	.8%	0.000
181-210	3	2.5%	.477
211-240	0	0.0%	0.000
241-270	2	1.7%	.301
Total	119	100.0%	

TABLE III.

TEN RECAPTURED SEATROUT SHOWING THE GREATEST LENGTH INCREMENT (MM.).

Release Date	Release SL	Release TL	Number of Days Free	Length Increment SL	Length Increment TL
20/XII/60	321	377	22	2	8
17/XII/60	315	367	88	4	11
5/XII/60	307	364	135	5	10
20/XII/60	366	426	135	11	10
16/XII/60	312	367	137	11	22
21/XII/60	303	357	47	16	20
17/XII/60	322	379	16	18	21
17/XII/60	390	341	38	50	58
7/XII/60	262	307	44	78	93
20/XII/60	280	329	70	112	--

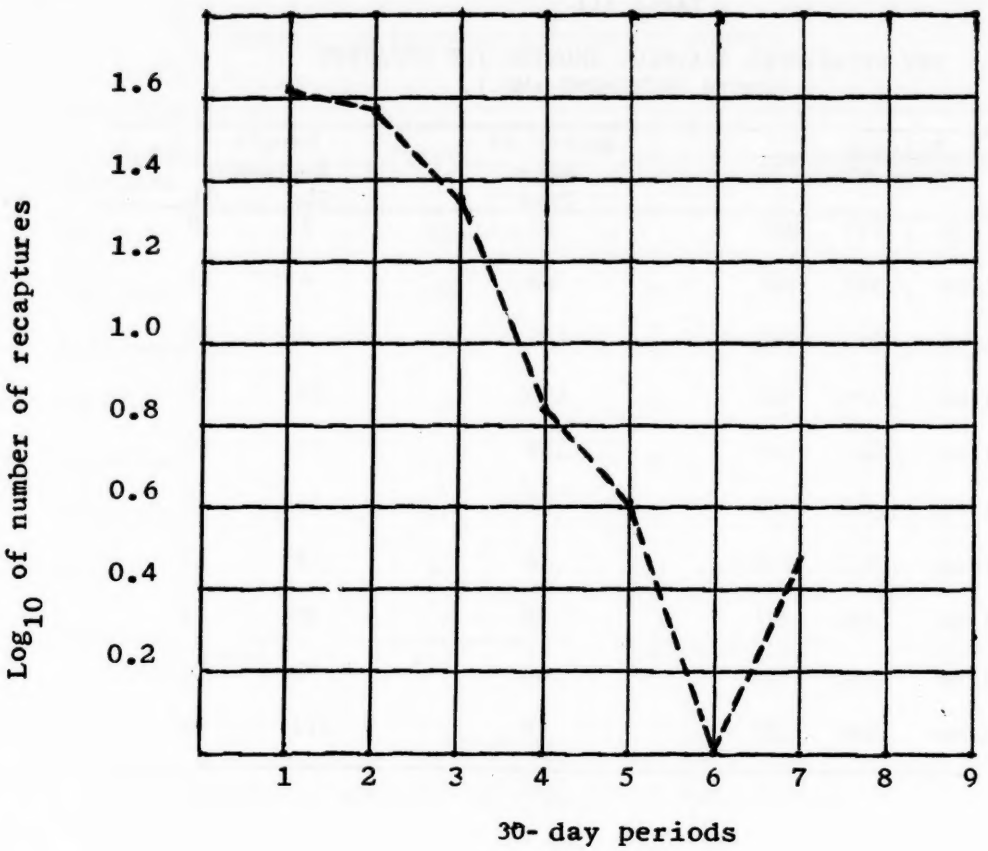

FIGURE 1. NUMBERS OF RECAPTURED SEATROUT BY 30-DAY PERIODS.

(see Table II for actual values)

RED DRUM, CHANNEL BASS, Sciaenops ocellata (Linnaeus):

Tagged red drum were released in Zone I from December 2, 1960 through January 3, 1961. Recaptured specimens were returned from December 7, 1960 through June 22, 1961. The longest distance traveled by a red drum was 112 miles in 186 days, an average of 0.60 miles per day. This fish was released on December 19, 1960 at City Island, Sarasota Bay and was recaptured at Cedar Keys. Another tagged specimen also free for 186 days was caught less than five miles from the release site as were 91.3% of the tagged specimens returned. 87.3% of the tagged specimens were captured less than 20 miles from the release site. The numbers of fish tagged and recaptured by county are listed in Table IV.

One hundred and fifty of 270 (55.6%) tagged red drum were returned. Eighteen of the recaptured fish were returned on January 1, 1961. One tag from a red drum was found entangled in a gill net, and there was a discrepancy between the release and recapture identity of another tagged specimen. These tags were deducted from the total number of fish tagged. These two tags were not considered in the compilation of data. Table V and Figure 2 show the returns by 30-day periods.

Thirty-three red drum free from 41 to 186 days before recapture showed an average increase in length of 29.2 mm. The ten fish exhibiting the greatest length increase are listed in Table VI. Only two red drum free for more than 40 days showed a length shrinkage. One fish free for 59 days and another free for 115 days showed a length shrinkage of 22 mm. and 7 mm. (average 14.5 mm.) respectively.

TABLE IV.

NUMBERS OF RED DRUM RETURNED BY COUNTY.

County	Number Tagged	Number Recaptured	Percentage
Hernando	3	0	00.0%
Pasco	6	4	66.7%
Pinellas	40	28	70.0%
Hillsborough	*45	*29	64.4%
Manatee	0	0	00.0%
Sarasota	82	57	69.5%
Charlotte	5	4	80.0%
Lee	22	13	59.1%
Collier	65	15	23.1%
Total	270	150	55.6%

*Does not include one tag found entangled in gill net.

TABLE V.

NUMBERS OF RED DRUM RETURNED BY 30-DAY PERIODS.

Days	Number Recaptured	Percentage Recaptured	Log_{10} Recaptures (see Figure 2)
1-30	83	55.7%	1.919
31-60	28	18.8%	1.447
61-90	20	13.4%	1.301
91-120	9	6.0%	0.954
121-150	6	4.0%	0.778
151-180	1	0.7%	0.000
181 - 210	2	1.3%	0.301
Total	149	100.0%	

Note: The above total does not include one fish for which the recapture date was not recorded.

TABLE VI.

TEN RECAPTURED RED DRUM SHOWING THE GREATEST AMOUNT OF LENGTH INCREMENT (MM.).

Release Date	TL	Number of Days Free	Length Increment TL
4/XII/60	380	106	34
7/XII/60	358	176	97
*7/XII/60	373	186	115
18/XII/60	233	137	123
18/XII/60	351	139	56
19/XII/60	356	139	39
19/XII/60	302	89	42
31/XII/60	350	89	47
1/I/61	385	58	40
1/I/61	343	140	49

*Late recovery (recovered June 10, 1961).

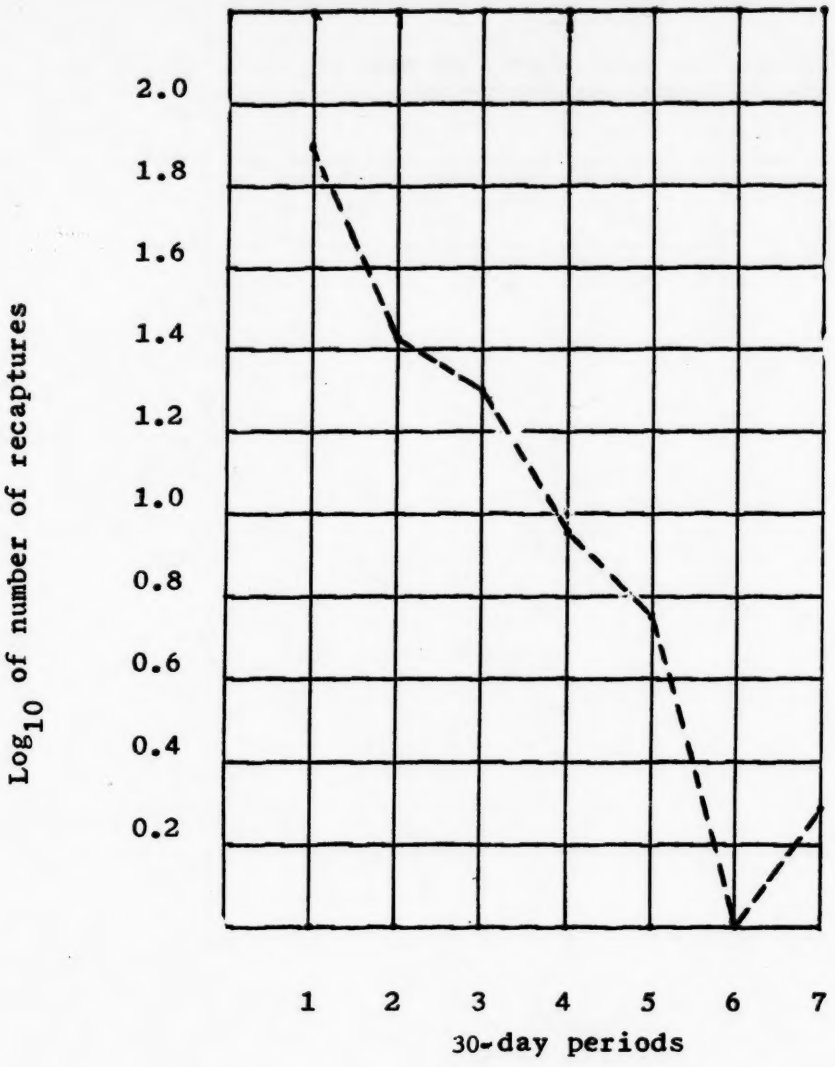

FIGURE 2. NUMBERS OF RECAPTURED RED DRUM BY 30-DAY PERIODS.
(see Table V for actual values)

SHEEPSHEAD, Archosargus probatocephalus (Walbaum)

A total of 55 sheepshead were tagged in Zone I from December 6, 1960 through December 31, 1960. Eighteen fish were recaptured from December 27, 1960 through August 27, 1961, showing a recovery rate of 32.7%. Sheepshead were released in five counties in Zone I. The number of fish tagged and recaptured by county is shown in Table VII.

Only one of the recaptured fish traveled more than 20 miles. This fish, released at Punta Gorda in Charlotte County on December 21, 1960, was recovered at Pine Island in Lee County on January 8, 1961. This rather large individual (total length: 430 mm. at release) traveled 25 miles in 19 days, covering an average distance of 1.32 miles per day.

The longest period that a fish was free was 250 days. This fish was released at the North Jetty in Nokomis (Sarasota County) on December 21, 1960 and recaptured on August 27, 1961 at Siesta Key, Sarasota County, less than ten miles from the point of release. The remaining 16 fish (88.4%) were recaptured within five miles of the point of release.

Table VIII and Figure 3 show the returns by 30-day periods. Here the straight-line relationship is not shown when plotting the 30-day periods against the logarithms of the returns. However, the proper relationship becomes evident in the other Zones, where sufficient data are available.

Of the 18 fish recaptured, 11 showed a length increment, two showed a length shrinkage and data were not available on the remaining five specimens. Of the two specimens showing a length shrinkage, one was free for 30 days and the other 19 days. Table IX lists the 11 specimens with a length increment.

TABLE VII.

NUMBERS OF SHEEPSHEAD RETURNED BY COUNTY.

County	Number Tagged	Number Recaptured	Percentage
Hernando	0	0	00.0%
Pasco	0	0	00.0%
Pinellas	9	5	55.6%
Hillsborough	12	2	16.7%
Manatee	0	0	00.0%
Sarasota	9	5	55.6%
Charlotte	4	1	25.0%
Lee	0	0	00.0%
Collier	21	5	23.8%
Total	55	18	32.7%

TABLE VIII.

NUMBERS OF SHEEPSHEAD RETURNED BY 30-DAY PERIODS.

Days	Number Recaptured	Percentage Recaptured	Log_{10} Recaptures (see Figure 3)
1-30	3	16.7%	0.477
31-60	2	11.1%	0.301
61-90	7	38.9%	0.845
91-120	2	11.1%	0.301
121-150	2	11.1%	0.301
151-over	2	11.1%	0.301
Total	18	100.0%	

TABLE IX.

ELEVEN SHEEPSHEAD SHOWING A LENGTH INCREMENT (MM.).

Release Date	TL	Number of Days Free	Length Increment TL
6/XII/60	186	130	45
11/XII/60	251	31	32
9/XII/60	258	73	36
9/XII/60	177	111	55
19/XII/60	266	73	27
21/XII/60	285	7	16
30/XII/60	259	69	18
31/XII/60	250	62	27
31/XII/60	233	72	18
31/XII/60	234	66	9
31/XII/60	225	59	47

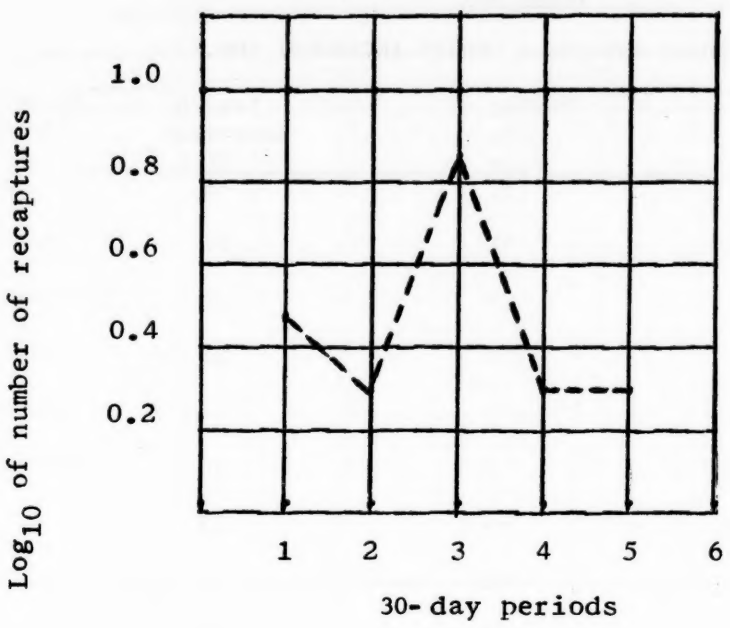

FIGURE 3. NUMBERS OF RECAPTURED SHEEPSHEAD BY 30-DAY PERIODS.

(see Table VII for actual values)

BLACK, OR STRIPED, MULLET, Mugil cephalus Linnaeus.

Black mullet were tagged and released in Zone I from December 6, 1960 through December 19, 1960. Thirty of 75 fish were recovered (40.0%) from December 16, 1960 through April 15, 1961. There was a discrepancy between the release and recapture identity of one tagged specimen. This specimen was not considered in the compilation of data. The numbers of returns by county in Zone I are shown in Table X.

The greatest distance traveled was approximately 23 miles by a fish released on December 11, 1961, at Sand Key in Boca Ciega Bay, Pinellas County, and recaptured on February 16, 1961, south of Gandy Bridge in Pinellas County. This fish was caught 68 days after release, and traveled an average distance of 0.34 miles per day. The longest period of time that a fish was free was 122 days. It was recaptured less than five miles from the point of release.

64.3% of the mullet were recaptured less than five miles from the point of release, and 96.4% were recaptured less than 20 miles from the point of release. One tag from a black mullet was found entangled in a net. This tag was deducted from the total number of fish tagged. It was not considered in the compilation of data.

Table XI and Figure 4 show the returns by 30-day periods.

Of 30 recaptured black mullet, 22 showed a length increment, seven a length shrinkage and data were not available for one specimen. Eleven specimens free for more than 61 days all showed a length increment. These 11 specimens and their respective length increments are shown in Table XII.

TABLE X.

NUMBERS OF MULLET RETURNED BY COUNTY.

County	Number Tagged	Number Recaptured	Percentage
Hernando	0	0	00.0%
Pasco	0	0	00.0%
Pinellas	41	13	31.7%
*Hillsborough	2	2	100.0%
Manatee	0	0	00.0%
Sarasota	4	1	25.0%
Charlotte	0	0	00.0%
Lee	28	14	50.0%
Total	75	30	40.0%

*Does not include one tag found entangled in net.

TABLE XI.

NUMBERS OF MULLET RETURNED BY 30-DAY PERIODS.

Days	Number Recaptured	Percentage Recaptured	Log_{10} Recaptures (see Figure 4)
1-30	11	36.7%	1.041
31-60	6	20.0%	0.778
61-90	9	30.0%	0.954
91-120	3	10.0%	0.447
121-150	1	3.3%	0.000
Total	30	100.0%	

TABLE XII.

LENGTH INCREMENTS (MM.) OF ELEVEN BLACK MULLET FREE FOR MORE THAN 61 DAYS.

Release Date	Release TL	Number of Days Free	Length Increment TL
6/XII/60	387	90	29
6/XII/60	410	111	33
6/XII/60	343	65	22
9/XII/60	371	111	54
9/XII/60	362	68	27
11/XII/60	370	79	17
11/XII/60	366	68	28
11/XII/60	390	81	42
16/XII/60	284	64	24
16/XII/60	305	113	46
16/XII/60	274	122	43

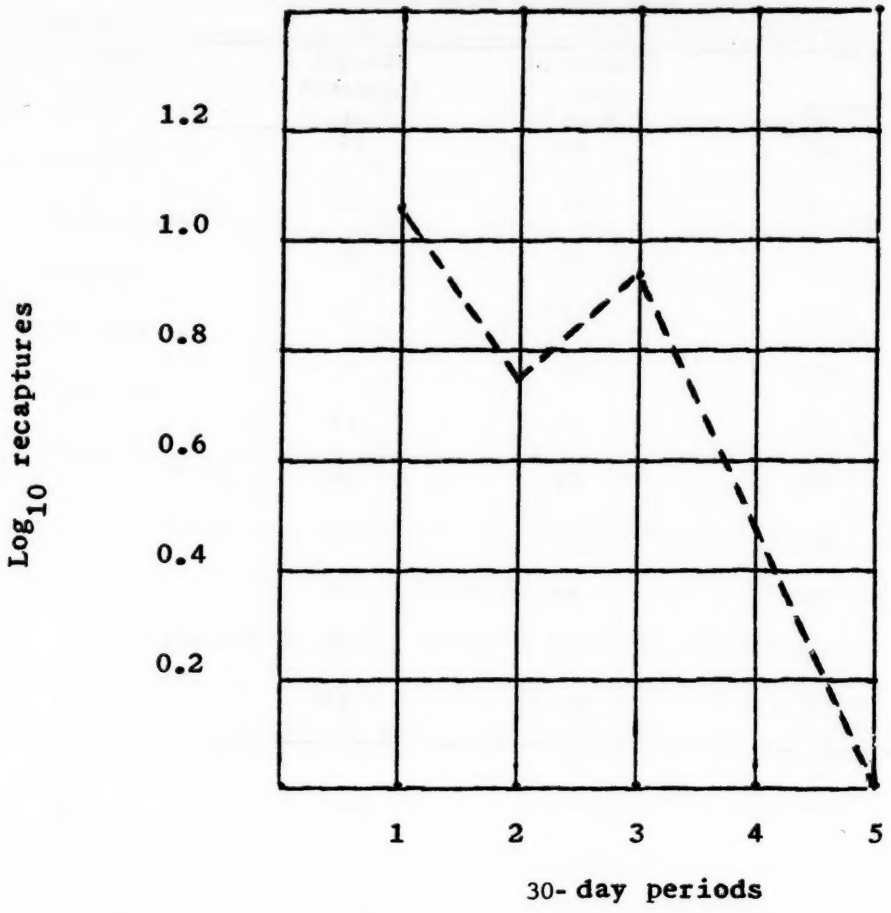

FIGURE 4. NUMBERS OF RECAPTURED BLACK MULLET BY 30-DAY PERIODS.
(see Table IX for actual values)

Miscellaneous Species

Table XIII lists a number of miscellaneous species of which less than 25 specimens of each species were tagged and released.

Seven of 22 (31.8%) tagged gray snapper, Lutjanus griseus (L.), were recaptured between 15 and 53 days from the release date. There was a discrepancy between the release and recapture identity of one tagged specimen. This specimen was not considered in the compilation of data. Only one of the eight recaptured specimens was caught more than five miles from the release site. This one specimen traveled from Naples Beach to Wiggins Pass, a distance of less than ten miles. Seven of the eight recaptured fish showed an average length increment of 11.7 mm. while one specimen free for 15 days exhibited length shrinkage.

One flounder, Paralichthys albigutta Jordan & Gilbert, free for 69 days, was recaptured less than five miles from release. It exhibited a length increment of 10 mm.

One southern sea bass, Centropristis melanus Ginsburg, free for 57 days, was caught about 26 miles from the release site. This specimen showed a length increment of 2 mm.

One sea drum, Pogonias cromis (L.), released in Collier County was free for 26 days and recaptured less than five miles from the release site. One specimen released in Pasco County and free for 21 days was recaptured less than ten miles from the release site. Both specimens showed a length shrinkage.

One sea catfish, Galeichthys felis (L.), released at New Pass, Sarasota County, was recaptured less than ten miles away in Sarasota Bay 78 days later. Another specimen was free for 81 days before recapture. The exact recapture location was not available. The specimens free for 78 and 81 days showed a length increment of 31 mm. and 36 mm. respectively.

TABLE XIII.

DATA FOR MISCELLANEOUS SPECIES.

Species	Number Tagged	Number Returned	% Returned	Mean Distance Traveled	Mean No. Days Free
Gray Snapper *Lutjanus griseus* (L.)	22	7	31.8%	6	33.9
Flounder *Paralichthys albigutta* Jordan & Gilbert	13	1	7.7%	5	69.0
Sea Bass *Centropristis melanus* Ginsburg	24	1	4.2%	26	57.0
Sea Drum *Pogonias cromis* (L.)	2	2	100.0%	8	23.5
Sea Catfish *Galeichthys felis* (L.)	6	3	33.3%	10	79.5
Southern Kingfish *Menticirrhus americanus* (L.) *sp. inq.*	4	0	00.0%	--	----
Snook *Centropomus undecimalis* (Bloch) *sp. inq.*	3	0	00.0%	--	----
Spadefish *Chaetodipterus faber* (Broussonet)	5	0	00.0%	--	----
White Mullet *Mugil ? curema* Valenciennes	4	0	00.0%	--	----

Discussion

All fishes returned to the Laboratory were identified. In Zone I, laboratory identifications differed in three cases from the field identifications. It does not seem likely that the field identifications were in error since the fishes involved (mullet, sheepshead, redfish, snapper) are well-known species, but rather that one of the following two things occurred:

1. There was a recording error, or

2. There was an exchange of tags. To be eligible for a cash award the fish was to be returned with tag attached. Since in at least two cases tags alone were found entangled in nets, it is conceivable that additional tags were found and subsequently attached to fishes.

Even if one included the three cases mentioned above as misidentifications resulting in a 0.9 per cent error of the fishes returned, the data presented here would not be appreciably changed.

Because of the $1000 bonus award for turning in the first fish captured after midnight December 31, 1961, it has been suggested that some fishes were caught in December and turned in on January 1st. Also, it is possible that some fishes caught in December may have been turned in after December 31, 1961, so as to eligible for awards higher than the $25 paid for fishes returned in December. With this in mind we analyzed the returns of fishes released after the last day of December, 1960 (see Table XIV). Of 89 fishes tagged after December, none was returned within ten days and only one was returned within 14 days of release. In general this is in agreement with the returns of fishes tagged and released in December, 1960.

Table XIV.

DATA ON FISHES RELEASED AFTER DECEMBER 31, 1960.

Date Released	Number Released	Species	Number of Days Free	Total Number Recaptured
January 1, 1961	27	Red drum	80)	
			140)	
			18)	6
			58)	
			88)	
			109)	
	4	Sheepshead		
	1	Snook		
January 3, 1961	14	Seatrout	13	1
	3	Red drum		
	2	Gray Snapper	16	1
January 4, 1961	37	Seatrout	21)	
			44)	
			68)	4
			57)	
Total	88			12

One of the rules of the Schlitz contest was that to be eligible for a cash award all fishes, with the exception of mullets, were to be caught by hook and line. It is very likely that there was some falsification of data concerning the method of capture. However, because of the nature of the program, method of capture was not considered vitally important in our studies on growth, movement and mortality, except where the falsification of data may have been extended beyond the method of capture.

Movement:

Tagged spotted seatrout recaptured in Zone I showed little evidence of movement with more than 98% of the fish traveling less than 20 miles from the release site. This tends to substantiate the finding of Moffett (1961) and Iversen and Moffett (1961), who gave evidence that spotted seatrout populations in west Florida do not migrate great distances although, in some cases, a few fish did move long distances.

Over 96 % of the black mullet recaptured were less than 20 miles from the release site. This is in agreement with the findings of Broadhead (1953), Broadhead and Mefford (1956) and Idyll and Sutton (1952). They found that most of the tagged black mullet did not travel far, usually less than 20 miles.

This study indicates that red drum, sheepshead and gray snapper, like the spotted seatrout and the black mullet, do not, with the exception of a few individuals, normally travel great distances. The only recaptured sheepshead which traveled over 10 miles was a specimen originally taken in the Gulf of Mexico and transported to brackish water at Punta Gorda. One possibility for its greater distance traveled, as compared with other recaptured specimens, was that it preferred high salinity waters.

At the time of this writing there was insufficient evidence to draw even tentative conclusions on movements of several other tagged species released in small numbers during this program.

Additional data on movement of fishes in Zone I is anticipated with the return of fishes free for relatively long periods of time.

Fishing Mortality:

The following factors probably had an effect on the assessment of fishing mortality:

1. High rewards ($25 minimum to a possible maximum of $10,000 per tagged fish).

2. Extensive publicity.

3. Tagged-fish releases were made in areas of heavy fishing pressure.

4. Only the larger fish of a species were tagged.

Table XV summarizes the data on returns for each of the major species tagged.

In the Schlitz program, 81 spotted seatrout were tagged in the Pine Island area and at the end of about four months approximately 38.4% of these were returned. Iversen and Moffett (op. cit.) estimate the abundance and mortality of a spotted seatrout population. They reported 5,409 fish tagged and released in the vicinity of Pine Island (Ft. Myers) during the period January 6 through 20, 1961. Recovery rate was 23.1 per cent from January 21 through May 31, 1961, a period of slightly over four months. Evidence is available that not all

tagged spotted seatrout recaptured in the study by Iversen and Moffett (op. cit.) were reported to them. This was mainly because of the low reward ($0.75) offered. A Quarterly Report (July 1 - September 30, 1961) from The Marine Laboratory, University of Miami, to the State Board of Conservation, stated that 28 per cent of the tags from the Pine Island area were returned by September 30, 1961. Likewise, because of reasons previously mentioned the Schlitz program probably increased temporarily the number of people fishing.

Thus, we have two tagged-fish studies. One with a high monetary return and heavy publicity, the other with more nominal rewards and only the usual public awareness. Returns of 38.4% and 28.0%, respectively, were noted for those two programs. Using the lower return in mathematical calculations, fishing mortality was estimated (Iversen and Moffett, 1961). It appears that a higher return figure and concomitantly higher fishing mortality may now be estimated.

These results are to receive more detailed evaluation.

The rate of recovery of black mullet in Zone I (40.0% in about four months) far exceeds the rate obtained in the tagging program reported by Broadhead and Mefford (op. cit.) in which a State-wide recovery of 22.8% during a five-year period was reported. However, the same workers reported a 37.0 percentage recovery in the Panama City area.

The most amazing rate of recovery in Zone I of the Schlitz program was that of the red drum; 55.6 per cent of the tagged red drum were returned in approximately 6-1/4 months.

Taking into account all species tagged in this program, the rate of recovery by October 1, 1961 was approximately 33 per cent

TABLE XV.

SUMMARY OF DATA ON RETURNS OF CERTAIN SPECIES.

	Number Released	Number Returned	% Return	Max. No. of Months Free
Spotted seatrout	513	119	23.2	8
Red drum	270	150	55.6	6½
Mullet	75	30	40.0	4
Sheepshead	55	18	32.7	8
Snapper	22	7	31.8	2

Growth:

Only general observations on growth have been included in this report. Growth will be discussed more fully in a later report. Several important factors influencing observations on growth in this program were:

1. Because of the nature of the contest only the larger fish of a particular species were tagged. (Scale samples were not used in growth studies).

2. In Zone I fishes turned in as having been caught on January 1st should not be considered since there is evidence that some of these fishes were caught prior to January 1st. The reason for turning them in on January 1st was to collect the $1000 bonus award for turning in the first tagged fish after the "official" opening of the contest.

3. Length shrinkage. Randall (1961) lists five sources which contribute to variations in a series of measurements:

   (a) Error in initial measurement.

   (b) Error in recapture measurement.

   (c) Shrinkage due to starvation.

   (d) Growth.

   (e) Variation in shrinkage after death.

   (a) and (b) constituted valid sources of variation throughout the Schlitz program. Human error can cause variations in successive measurements of the same fish by the same person. Larger differences are obtained when the successive measurements are made by different persons, as was sometimes unavoidably the case for the release-recapture measurements in this program.

Variation in shrinkage after death probably accounted for most of the shrinkages observed in the Schlitz Tagging Program. Several observers have reported that a definite shrinkage does occur due to dessication, icing, or freezing. Randall (op. cit.) measured 17 convict surgeonfish (Acanthurus) following partial drying and/or freezing. These fish were all 1 to 7 mm. shorter than when first measured. In a marking experiment with yellowtail flounders (Limanda), Lux (1960)

measured recaptured fish in a landed condition. He noted a mean shrinkage of 1.16% for fish caught two weeks after release. In an experiment to show these effects more directly, Lux (op. cit.) measured 72 live yellowtail flounders, then froze and remeasured the fish. All fish were shorter at the second measurement, with the mean shrinkage being 1.47% of the total length. Similar results were obtained by Moffett (1959), who showed the mean shrinkage of seatrout (Cynoscion nebulosus) after preservation on ice was 2 mm. (0.61%) and the shrinkage after freezing was 5 mm. (1.53%). In Zone II of the Schlitz Tagging Program (preliminary analysis) total mean shrinkage for barracuda (Sphyraena barracuda) was 8.51 mm. (1.35%). A much higher value was shown (1.92%) for fish recaptured within 30 days of the time of release.

Another important source of variation in measurement was not considered by Randall (op. cit.). This was damage to fish. Damaged fish should be eliminated from consideration in growth studies.

Improvements in the 1961-1962 Tagging Program:

As was previously mentioned, the 1960-61 tagging program was considered to be that of a pilot program because there was little time available for adequate planning before tagging started. With the cooperation of the sponsor, several modifications and improvements have been scheduled for the 1961-62 program, through which more meaningful data may be obtained. It is hoped that these improvements will facilitate the valid assessment of several parameters in the forthcoming program. The following modifications have been introduced this year:

1. The employment of a single team (a biologist and an assistant) to handle the tagging program should eliminate any gross discrepancies from the data, and provide more accurate length measurements.

2. Since there was an indication during last year's tagging that some fish may have been held for several days in order to collect the $1000. first-fish-award, this award has been eliminated from the 1961-62 program.

3. Some tagged fish undoubtedly will be caught prior to the official opening of the contest on January 1, 1962. In the 1960-61 contest, these fish were worth $25 to the catcher; this year the fish will be worth the full reward regardless of the early capture date.

4. Experimental work (length-shrinkage studies, mortality experiments with tagged and untagged fishes, etc.) will be conducted.

5. A higher number of fishes will be tagged.

References

BROADHEAD, G. C. 1953. Investigations of the black mullet, Mugil cephalus L., in northwestern Florida. Florida State Bd. Conserv., Tech. Ser. No. 7: 33 pp.

BROADHEAD, G. C. and MEFFORD, H. P. 1956. The migration and exploitation of the black mullet, Mugil cephalus L., in Florida, as determined from tagging during 1949-1953. Florida State Bd. Conserv., Tech. Ser. No. 18: 31 pp.

IDYLL, C. P. and SUTTON, J. W. 1952. Results of the first year's tagging of mullet, Mugil cephalus L., on the west coast of Florida. Trans. Amer. Fish. Soc., 81: 69-77

IVERSEN, E. S. and MOFFETT, A. W. 1961. Estimation of abundance and mortality of a spotted seatrout population. Presented at the Amer. Fish. Soc. Ann. Meeting, Sept. 14-15, 1961.

LUX, F. E. 1960. Length shrinkage of yellowtail flounder between live and landed condition. Trans. Amer. Fish. Soc., 89(4): 373-374.

MOFFETT, A. W. 1959. Preliminary report on the migrations and growth of the spotted weakfish in west Florida as determined by tagging during September, 1958 through May, 1959. Florida State Bd. Conserv., Prog. Rept., Oct., 1959.

MOFFETT, A. W. 1961. Movements and growth of spotted seatrout, Cynoscion nebulosus (Cuvier), in west Florida. Florida State Bd. Conserv., Tech. Ser. No. 36: 33 pp.

RANDALL, J. E. 1961. A contribution to the biology of the convict surgeonfish of the Hawaiian Islands, Acanthurus triostegus sandvicensis. Pacific Sci., 15(2): 215-272.

THE MARINE GAME FISH RESEARCH PROGRAM
BUREAU OF SPORT FISHERIES AND WILDLIFE

Presented by

Albert Swartz

BUREAU OF SPORT FISHERIES AND WILDLIFE
U. S. FISH AND WILDLIFE SERVICE
Washington, D. C.

at the Sixth

INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida

November 15, 1961

THE MARINE GAME FISH RESEARCH PROGRAM
BUREAU OF SPORT FISHERIES AND WILDLIFE

by Albert Swartz

Assistant Chief
Branch of Fishery Research

The marine game-fish research bill was passed in 1959. This new legislation gives recognition to the fast-moving trend toward the excitement and satisfaction of salt-water fishing and to the need to know more about the resources on which it depends. The opening section of this Act reads as follows:

> "An Act authorizing and directing the Secretary of the Interior to undertake continuing research on the biology, fluctuations, status and statistics of the migratory marine species of game fish of the United States and contiguous waters".

Given such an authorization, where would you start? In reaching a decision no doubt you would think first about the geography of your problem - three major coastlines with some 80,000 miles and boundless water areas; at least five different faunas based on zoogeographical lines and several hundreds of species of fish of interest to anglers. Almost all are migratory to some extent, ranging from the winter flounder and white perch with limited local movements, to the large group of fish which move along the coast or from inshore to offshore waters; and finally to the transoceanic species such as albacore and tuna. You would think about the fisherman and the fisheries. For example, how many salt-water anglers are there; which is their distribution; what species do they catch and how many of each? What kind of facilities do they use and how much do they spend?

At this point you would have three key elements of your problem in mind: the fishes, their environment, and the angler. How can these be fitted together to make a coherent National program of marine sport fishery research?

In the past 18 months we in the Bureau of Sport Fisheries and Wildlife have given much though to these questions and to many more. In the process we have asked for assistance from many of you in the State organizations, the universities, the interstate fisheries commissions, and the Sport Fishing Institute. As a result we have set some broad program guidelines and principles to chart our course into the future. They are as follows:

1) to perform basic, long-term research;

2) to use an ecological approach;

3) to define the National dimensions of the recreational fishing and to develop methods to assess it periodically;

4) to stimulate the recruitment and training of marine fishery biologists;

5) to assist in the problem of scientific communication;

6) to provide leadership and coordination in wide ranging cooperative studies.

This is all very well you may say, but what are you doing now? In reply, first of all let me say that the Act authorizes up to $2.7 million annually but we are currently operating on a budget of about $150,000, obviously too small an amount to cut an impressive figure on the beach. Nevertheless, we have already made a start - modest though it may be - along the lines to which we are committed.

Our first step was to acquire a laboratory. This took place a little more than one year ago in August 1960. We acquired a former Army hospital at Fort Hancock, New Jersey. This laboratory is on the shores of Sandy Hook Bay and under the direction of Dr. Lionel Walford who will tell you more about his program very shortly.

We have completed, by contract with the U. S. Bureau of Census, a national poll to collect catch statistics of marine game fishing, which will form an essential background for directing future research. The poll included the methods of fishing which salt-water anglers used during 1960 and the principal species and quantities caught, by regions. This project was a supplement to the Bureau's 1960 National Survey of Hunting and Fishing. A final comprehensive report will be published early next year.

I would like to give you some preliminary findings later.

A first step in defining the National Marine Sport Fishery is to take inventory of its facilities--the boats, liveries, and landing ramps; the jetties, piers, and beaches; the fishing bottoms, bays, reefs, and wrecks. To provide this description, we have made a review of published and unpublished records available from various sources. Field surveys are being carried out to verify and supplement presently available records. A catalog of facilities is being developed and plotted on charts to form a National marine game fishing atlas.

Another function of the program will be to compile and systematize existing knowledge on marine game fishes and their environment. This activity will result in an organized collection of published and unpublished reports and data, including an inventory of past and present research projects. The result will be a compedium of research materials which should be useful to scientists, administrators, and the general public. The compendium will be published at intervals in sections according to subject. Subjects under preparation are the dolphins, weakfishes, bluefish, striped bass, and coastal hydrography.

Fishes occupy a variety of nursery habitats. Many coastal fishes, including some of the most important migratory game species, find their nursery grounds in the protected and nourishing water of estuaries, bays and rivers. Consequently, we hope to give special attention to the estuarine environment. We have started a pilot study consisting of a systematic sampling of plankton at the mouth of the Shrewsbury estuary. This will determine the species of young fishes, their sizes, relative abundance, and times of arrival and departure. We hope to extend such studies to other estuaries by collaboration with State and private marine laboratories. Meanwhile, as the installation of the sea water system, aquaria, and tanks at Sandy Hook laboratory is completed, we shall begin experimental studies to determine the factors affecting survival and well-being of juvenile game fishes. In connection with these studies a microbiological laboratory has been established to culture phytoplankton and zooplankton species. Once this is underway, an extensive screening program will be undertaken to find suitable food organisms for rearing larval sport fishes.

Another important part of the marine game fish research activity will be graduate studies sponsored and financed by the Bureau. This program has two purposes: 1) to stimulate the recruitment of marine biologists to the field of fishery research; and 2) to fill in the gaps on marine game fish problems. Students will be encouraged to undertake problems which may be integrated with larger investigational programs of the Bureau. Selection of students will be by the university rather than by the Bureau.

Rather than spread our limited resources too thinly, we elected to build up the staff and facilities at Sandy Hook during the first year. Mindful, however, that our authorization establishes a National program, steps have been taken to make it so. First, both the survey of fishing and the facilities inventory are National in scope. Second, a systematic effort was made to define our objectives and develop our program in a series of meetings with the three interstate fishery commissions representing the States on the Pacific, Gulf, and Atlantic coasts. Finally, after a careful search, a center for marine game fish study on the Pacific Coast has been selected. It is located at Tiburon, California, on San Francisco Bay. As funding permits, our staff, facilities, and program will be built up to compare with the Atlantic coast center at Sandy Hook.

To return to the Salt-water Census, I believe that most of you are familiar with the 1960 National Survey of Hunting and Fishing, the results of which were published in September. In order to get more details on salt-water angling, a special adjunct to this survey was conducted by the Bureau of the Census. Although the analysis of statistics from the latter has not been completed, the main dimensions of marine sport fishing on a national scale are now available for the first time. They are truly impressive.

Time does not permit me to give you all the details but I should like to take a few minutes here, however, to give you some of the highlights of the angling catch by regions.

A total of 6.3 million salt-water anglers spent 80 million man days at their sport in 1960 and caught about 630 million fish. Roughly one-half of the fishing was on the Atlantic Coast and the other half was, evenly split between the Gulf Coast and the Pacific Coast. The most productive area in terms of catch-per-unit-of-effort was the South Atlantic area, followed closely by the Gulf Coast. The fishes which occurred most frequently in the catches are shown below by regions:

NORTH ATLANTIC AREA - from Maine to New York

Flounder	-	19,500,000
Porgy	-	15,000,000
Mackerel	-	10,000,000
Fluke	-	9,000,000
Smelt	-	6,000,000
Blowfish	-	6,000,000
Bluefish	-	5,000,000
Pollock	-	4,000,000
Cod	-	4,000,000

MIDDLE ATLANTIC AREA - from New Jersey to Cape Hatteras

Spot	-	23,000,000
White perch	-	13,000,000
Flounders	-	12,000,000
Bluefish	-	12,000,000
Croaker	-	8,000,000
Black sea bass	-	7,000,000
Striped bass	-	7,000,000
Tautog	-	5,000,000

SOUTH ATLANTIC AREA - from Cape Hatteras to the Florida Keys

Grunts	-	19,000,000
Kingfishes	-	18,000,000
Mullet	-	17,000,000
Sea trouts	-	15,000,000
Porgies	-	11,000,000
Snappers	-	9,000,000
Sea catfish	-	9,000,000
Drums (red & black)	-	9,000,000

GULF - from West Coast of Florida to Mexico

Sea trout	-	65,000,000
Croakers	-	32,000,000
Sea catfish	-	22,000,000
Drums (red & black)	-	15,000,000
Groupers	-	9,000,000
Porgies	-	9,000,000
Kingfishes	-	7,000,000
Mackerels	-	5,000,000

SOUTH PACIFIC - from Point Conception to Mexico

Pacific bonito	-	12,000,000
Pacific barracuda	-	7,000,000
Pacific and jack mackerels	-	7,000,000
Kelp or sand bass	-	5,000,000
Rockfishes	-	3,000,000
Surfperches	-	3,000,000
Yellowtail	-	2,000,000

NORTH PACIFIC - from Point Conception to Alaska

Cabezon (sculpins)	-	8,000,000
Surfperches	-	3,000,000
Smelts	-	3,000,000
Striped bass	-	3,000,000
Flounders	-	3,000,000
Greenlings	-	2,000,000

You may be interested in comparing the number of anglers and their catch by regions. The summary figures are:

Region	Anglers (millions)	Catch (millions)
North Atlantic	1.2	97
Middle Atlantic	1.3	115
South Atlantic	1.0	157
Gulf of Mexico	1.4	185
South Pacific	.7	50
North Pacific	.7	29
Total	6.3	633

Dick Stroud has told you about the phenomenal growth in salt-water fishing. The statistics on catch and effort that I have presented are further evidence of the fact that salt-water fishing is now a major industry. Even more important it is a substantial part of the tremendous and growing demand for outdoor recreation which contributes so much to the health and vigor of our Nation.

More than ever before we need to accelerate our knowledge and understanding of the coastal ecosystem. Only with such broad understanding can we assess man's demands upon its resources, the effects of man's activities on the environment, and the relations of fishes to the dynamic and complex elements in this environment.

A PROPOSAL FOR A COOPERATIVE STUDY OF THE ATLANTIC CONTINENTAL SHELF

Presented by

Lionel Walford

BUREAU OF SPORT FISHERIES & WILDLIFE
U. S. FISH AND WILDLIFE SERVICE
Highlands, New Jersey

at the Sixth

INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida

November 15, 1961

A PROPOSAL FOR A COOPERATIVE STUDY OF THE ATLANTIC CONTINENTAL SHELF [1]

By Lionel Walford

Laboratory Director
Sandy Hook Marine Laboratory
Bureau of Sport Fisheries & Wildlife
U. S. Fish and Wildlife Service
Highlands, New Jersey

Every fisherman is chronically baffled by the fickleness of his luck. Whether he casts from a skiff along shore for sport or drags a trawl over the banks for his livelihood, he asks the same kinds of questions: Why do fish prefer some areas to others? What makes them change their preferences? What forces are behind the changes in the times when they appear on the fishing grounds? Why does a species that has been abundant for a long time become scarce and remain so for many years? Biologists are also quite conscious of these questions, and although we have given considerable attention to them in research programs, we too remain baffled by them to a considerable degree. We are sure that it is the environment which in various ways determines the times and places that fish appear near the coast and the duration of their stay, the courses of their migrations, the fluctuations of their abundance, and the success of their spawning. But the fact is that although we may say "environment" very easily, if not glibly, to explain the unknown, we have only partial understanding of its workings. We know first of all that environment is a property of the individual fish. It includes others of its own kind and other creatures which affect it in various ways--as food, enemies, competitors, intermediate hosts of parasites and diseases; it includes the water with its organic and inorganic chemical constituents; the regime of temperature and light; the bottom sediments....

If we know this much, isn't that enough? Why can't we answer all your questions? Shouldn't we be able to explain, for example, why the mackerel are less than three per cent as abundant now as they were in 1929, while the scup seems to have increased three-fold during the same time? Shouldn't we know exactly what properties of the estuarine zone are biologically critical so that we might fortify them by artifice? What do we need in order to do these things?

We need to analyze environment so that we can construct for each species a total picture of the details of its distribution in relation to all of the properties of the sea which affect it. This requires a field study of massive proportions; for all species that we are concerned with extend over very large distances, ranging from hundreds to thousands of miles. In trying to construct total pictures of species and their environments in the past, we have fallen into the

---

[1] This proposal was presented to the 20th Annual Meeting of the Atlantic States Marine Fisheries Commission, New York.

error of undertaking this enormous job with absurdly insufficient equipment, trying to make do with whatever means we had at hand, however inadequate. For more than 80 years marine scientists have painstakingly collected various kinds of data whenever they could along the Atlantic coast, but all their observations add up to a collection of fragments, representing different areas, different seasons, different years and different methods, and these cannot be fitted together to reconstruct pictures with which to explain sequences of events over the years. It is as though we tried to piece together a motion picture drama from a few minute spots on occasional frames of a long film.

In order to analyze the environments of our Atlantic fish resources we must first gather enough of the right kinds of data. Fortunately, the great bulk of Atlantic species which are important in commerce and game spend their entire lives on the plateau bordering our coast which extends from the estuarine zone out to the beginning of the steep slopes at about 100 fathoms. This precious strip of ground, which is the Atlantic continental shelf, from Maine to Texas yields more than 70 per cent of the total United States sea harvest. That being true, I don't see how we can over-emphasize the importance of studying it thoroughly.

What I mean by a thorough study is a comprehensive, systematic and synoptic oceanographic surveillance of the entire Atlantic continental shelf. In other words, we should cover the whole shelf with observations of every facet of environment that we know, at points closely spaced along the course of lines radiating out from the shore which are at most about 10 miles apart. We should repeat observations monthly to study seasonal cycles, and continue the program for a long enough time to follow year-to-year changes. Over this network of points we should take temperatures from surface to the bottom, samples of the water for chemical analysis, and data on the distribution, abundance, and species composition of all kinds of animals and plants.

How could such an enormous job be done? It would require a fleet of at least 12 well-equipped research vessels all working in unison; and a large working force of scientist, including fishery biologists, zoologists, botanists, physical oceanographers, chemists, and geologists to plan and carry out the program and to collate the data. All of this is quite beyond the capacity of any one research institution. No one has the necessary assortment of talent, enough ships or enough money to do the job. We all recognize this, even while we admit that the job has to be done. It is not only people concerned with fish resources who need such data as I describe. Those working in all the marine sciences dealing with coastal problems of large scale share the same need; and all are similarly frustrated by the lack of sufficient data or the means to gather them.

This problem was a principal subject of discussion at a meeting of aquatic biologists at Lebanon, New Jersey last year. And Paul Hamer, of the New Jersey Department of Conservation and Economic Development, suggested that what is needed is an Atlantic continental shelf program comparable to the International Geophysical Year. From that idea evolved the concept of an Atlantic Shelf Campaign. If all the marine laboratories from Maine to Texas were to collaborate in the planning and execution, something approaching our idal of a synoptic and systematic surveillance could be possible. Each participating institution would be responsible for working over a particular section of the coast, and would gather certain data basic to the whole program and common to the needs of all the marine sciences, in addition to whatever it required to meet its own special needs. At times it would collect material for other cooperators. The basic data would be sent to the National Oceanographic Data Center for processing and publishing so that it would be available to all scientists.

The Atlantic Shelf Campaign is essentially a plan to make the best use of men, ships and equipment to get a job done which, we all agree, desperately needs to be done, and which probably could not be done otherwise. Even as it is, if all the laboratories of the Atlantic coast and the Gulf of Mexico were to combine their resources today, they would not have among them enough to carry out a synoptic study of the Atlantic Shelf. Nevertheless, we should not allow our present inadequacies to divert us from recognizing our problem and stating honestly how much is required to solve it. At the very least we should do that; it is the first necessary step towards getting the needed support.

During the past year I have discussed the Continental Shelf Campaign idea with biologists of all the Atlantic coastal states' fishery agencies in section meetings of the Atlantic States Marine Fisheries Commission; and in addition before the Shallow Water Research Conference in Baltimore which was attended by marine scientists representing university, state and federal laboratories. I posed these questions: Is a comprehensive, systematic and synoptic study of the environment of the continental shelf of eastern United States a necessary thing to undertake? Never mind the enormousness of it; never mind our limitations; never mind the cost. At this stage let us consider only the question--is this a necessary thing to do? If so, would you participate in the planning and execution? The response from each group has been an unqualified "yes". We agreed then that although something might be started fairly soon, the full-scale program would probably not get underway before about 1965. Meanwhile, a committee should be formed consisting of persons representing all the marine sciences and all the Atlantic coastal laboratory. This committee would lay down the basic requirements of an Atlantic Shelf Campaign, and determine what further facilities, manpower, and funds would be needed over and above what are not available. We would seek a sponsoring agency to help in our organizational problems and to act as a single representative of all our diverse interests. The American Institute of Biological Sciences might agree to act in this capacity. At the Baltimore Shallow Water Research Conference I was asked to form a committee for the Atlantic Shelf Campaign and to arrange its first meeting as soon as possible.

POST SCRIPT: Following the above talk, the proposed Committee held its first meeting at the American Museum of Natural History in New York on December 8th. Present were 36 scientists representing almost as many laboratories from Massachusetts to Texas. Subcommittees were formed for biology, geology, and physical oceanography. Each drew up a preliminary statement of objectives and requirements. A steering group was appointed to coordinate these statements, and to explore ways and means of developing the plan further. The American Institute of Biological Sciences agreed to serve as the Committee's sponsoring agency.

EXPLORATORY FISHING IN THE FLORIDA KEYS

Presented by

Walter A. Starck II

INSTITUTE OF MARINE SCIENCE
UNIVERSITY OF MIAMI

Miami, Florida

at the Sixth

INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida

November 15, 1961

EXPLORATORY FISHING IN THE FLORIDA KEYS

by Walter A. Starck II

Institute of Marine Science
University of Miami

Over the past several years The Marine Laboratory of the University of Miami has been periodically engaged in various types of exploratory fishing off the Florida Keys.

The area worked is bounded by the outer edge of the reef on one side and by the 100-fathom curve on the other. Its long axis extends northeast and southwest from Tennessee Reef to about Conch Reef. The bottom for the most part is composed of various mixtures of mud and sand, and slopes very gently to seaward. There are patches of algae and some coral in depths down to about 150 feet. Occasional rock patches and ledges break the contour in places. Along the outer edge of the area, in depths of 65 fathoms or more, the bottom becomes rougher. There is at least one trench with vertical walls which drops down to slightly below 100 fathoms from a surrounding depth of about 65 fathoms; and there are several small sea mounts, one of which rises to a depth of only 48 fathoms on top from a surrounding depth of 85 fathoms.

The inner edge of the Florida Current varies from over the outer reef to well offshore at about the 50-fathom curve or further. A counter current is present occasionally, and I have seen it extend off as much as 10 miles. When the current is running strong, "rips" form over the various features of the rougher bottom offshore, and on one occasion a current of 8-10 knots was encountered over the 48-fathom rise.

Up until World War II most fishing offshore in the Keys was confined to the reefs, with some surface trolling for pelagic species for a mile or two beyond the outer reef. During the War a few commercial fishermen began to fish for red snapper (Lutjanus blackfordi) out to 150- to 175-foot depths with handlines. After the war when sport fishing resumed, a few of the charterboat skippers began to deep-troll for red snapper and other species with rod and reel. After this there was a general trend toward fishing further offshore both for bottom fish and pelagic species.

One summer in the early 1950's, a charterboatman ranging a little farther off than usual ran across a large area of whitecaps on an otherwise calm day. These whitecaps were the rip caused by current flowing over the 48-fathom seamount which was later to become well known to local residents as the "Hump".

EXPLORATORY FISHING IN THE FLORIDA KEYS

by Walter A. Starck II

Institute of Marine Science
University of Miami

Over the past several years The Marine Laboratory of the University of Miami has been periodically engaged in various types of exploratory fishing off the Florida Keys.

The area worked is bounded by the outer edge of the reef on one side and by the 100-fathom curve on the other. Its long axis extends northeast and southwest from Tennessee Reef to about Conch Reef. The bottom for the most part is composed of various mixtures of mud and sand, and slopes very gently to seaward. There are patches of algae and some coral in depths down to about 150 feet. Occasional rock patches and ledges break the contour in places. Along the outer edge of the area, in depths of 65 fathoms or more, the bottom becomes rougher. There is at least one trench with vertical walls which drops down to slightly below 100 fathoms from a surrounding depth of about 65 fathoms; and there are several small sea mounts, one of which rises to a depth of only 48 fathoms on top from a surrounding depth of 85 fathoms.

The inner edge of the Florida Current varies from over the outer reef to well offshore at about the 50-fathom curve or further. A counter current is present occasionally, and I have seen it extend off as much as 10 miles. When the current is running strong, "rips" form over the various features of the rougher bottom offshore, and on one occasion a current of 8-10 knots was encountered over the 48-fathom rise.

Up until World War II most fishing offshore in the Keys was confined to the reefs, with some surface trolling for pelagic species for a mile or two beyond the outer reef. During the War a few commercial fishermen began to fish for red snapper (Lutjanus blackfordi) out to 150- to 175-foot depths with handlines. After the war when sport fishing resumed, a few of the charterboat skippers began to deep-troll for red snapper and other species with rod and reel. After this there was a general trend toward fishing further offshore both for bottom fish and pelagic species.

One summer in the early 1950's, a charterboatman ranging a little farther off than usual ran across a large area of whitecaps on an otherwise calm day. These whitecaps were the rip caused by current flowing over the 48-fathom seamount which was later to become well known to local residents as the "Hump".

Blackfin tuna (Thunnus atlanticus), oceanic bonito (Katsuwonus pelamis), and dolphin (Coryphaena hippurus) were concentrated in the area and several boats fished there when they could find it. A few people tried to fish the bottom with the result of a lot of broken tackle and a few fish.

Al Pflueger heard about the area and brought his boat, the "Gunner II," down to fish it. With electric reels and stainless steel cable we soon began to find out what was on the bottom. As fast as a line would hit bottom, and sometimes before, a strike would occur. We even had strikes on the lead sinkers, and on one occasion I caught two groupers on a single hook at the same time. Sharks were plentiful and even bit off Warsaw groupers (Epinephelus nigritus) which weighed up to 150 lbs. or more. One great white shark (Carcharodon carcharias) has been caught in the area.

Eventually we began to get some idea of the makeup and distribution of the fish fauna of the area. The blackline tilefish (Caulolatilus cyanops) is common in sandy areas in depths of 50 fathoms or more. A few northern tilefish (Lopholatilus chamaeleonticeps) have been caught. The latter fish was the basis of a considerable fishery off New England until a change in temperature was believed to have killed them by the millions in 1882. In the rocky areas speckled hinds (Epinephelus drummondhayi), yellowedge groupers (E. flavolimbatus), snowy groupers (E. niveatus), and Warsaw groupers are common. Occasionally red snappers are also caught. Almaco jacks (Seriola falcata), and great amberjacks (S. dumerili) are both present over the "Hump". The present all-tackle, world-record amberjack of 123 lbs. comes from there, and a larger specimen of 128 lbs. has been caught. Two large rudderfish (Palinurichthys sp.) have been taken which at the time of their capture had not been recorded south of Cape Hatteras. Several blue marlin (Makaira nigricans) have been hooked in the area and several others seen. A large swordfish (Xiphias gladius) has been seen on the surface, and in April 1958 I caught an 8-foot silky shark (Carcharhinus floridanus) which had a piece of swordfish bill projecting from its back. Yellowfin tuna (Thunnus albacares) up to 40 lbs. and blackfin tuna have also been caught around the hump. Occasionally, heavy objects were hooked which always pulled free when we tried to raise them. When the hooks were raised a small amount of jelly-like substance was stuck behind the bait. It is possible that this substance might be from a giant squid (Architeuthis). One of these animals was found washed ashore on Indian Key several years ago, so they do occur, occasionally at least, in the Florida Straits.

In 1959 the late Mr. Eric Heckett of Valencia, Pennsylvania and Cay Cay, Bahamas, offered The Marine Laboratory the use of his boat, Heckmere, for several months each year. The Heckmere is a 36-foot Prowler equipped with two electric-powered deep-fishing reels, the larger of which holds 5000 feet of 1/8-inch stainless steel cable. In

addition the Heckmere has a recording fathometer, fishfinder, radio direction finder, loran, and 100-volt alternating current which allows us to use almost any equipment we need.

The use of the Heckmere has allowed us to collect good specimens of the deeper-water fishes in the vicinity of the "Hump," and to gain more accurate information on their depth ranges, feeding habits, life colors and relative abundance. In addition, adequate series of some of these species are being made available to ichthyologists for the first time, and we are now in a position to solve some of the systematic problems of the species involved.

Last August a week was spent trawling with the Heckmere using a shrimp trynet in depths ranging from 20 to 100 fathoms. By this method we collected a number of smaller species as well as the juveniles of several of the deeper-water groupers and snappers which we had not taken before. Trawling also resulted in some very nice collections of deeper-water shrimps, crabs, and starfish, several of which are undescribed species. In the deeper areas from 50 to 100 fathoms the trawl would often come up covered with small brittlestars which are an important food of the tilefish in this area. By the end of the week Al Bauer, the captain of the Heckmere, was prefacing his calls over the radio with "Hello, this is the dragger Heckmere." He finally smiled, though, when on the last day the trawl hooked on something and we brought up nothing but the otter boards.

Along the inner edge of the area from the edge of the reef out to about 30 fathoms, Henry Feddern of The Marine Laboratory and I have done considerable diving. This method has made possible the collection and observation of species which live in rocky areas or burrows which could not be obtained otherwise. We have collected by this method the young of the silk snapper (Lutjanus vivanus) and snowy grouper, and another small grouper which we have been unable to identify. Possibly it is a new species. A good number of smaller species have also been taken including two new species of sea basses and a number of other fishes and invertebrates which have not been previously recorded from U. S. waters.

Nightlighting from the Heckmere has been another very productive method. We have two 150-watt bulbs in waterproof housings which are put over the stern just below the surface at night to attract small fish which are then dipped up. To my knowledge, no explanation has been offered as to why fish are attracted to a light; however, the following is one possibility. The only way by which a fish can change its angular relation to light from the sun or moon is by changing direction. When a point source of light is placed in the water, however, a passing fish continually changes its angle to the light even through it is swimming in a straight line. In order to maintain its angular relation to the

light, it continues to change its course which puts it in a circle around the light; and around and around it goes in an ever decreasing spiral. The only other way in which it can maintain its angular relation to the light is to swim straight toward the light which also often happens. It has been suggested that pelagic fishes navigate by using the polarized portion of sunlight as do bees and some other insects. If this is so, a cylindrical polaroid filter around the light might tremendously increase its ability to attract fish, which is something I hope to try in the future.

Nightlighting has yielded some very nice collections of the hard-to-get young of oceanic gamefish. We now have a number of specimens of small sailfish (Istiophorus albicans) and dolphin, as well as small bonito (Euthynnus alletteratus), king mackerel (Scomberomorus cavalla), several species of flyingfish and halfbeaks, including the flying halfbeak (Euleptorhamphus velox). This is a halfbeak which can glide like a flyingfish for short distances. The pelagic young of reef and inshore species are also collected in this manner. These include young squirrelfish (Holocentrus spp.), goatfish (Mullidae), surgeonfish (Acanthurus spp.), mullet (Mugil spp.), and various other species.

In addition to the work with the Heckmere, Col. John K. Howard, a field associate of The Marine Laboratory, has done considerable fishing in the area off Alligator Reef and has supplied us with a number of specimens of pelagic gamefish. Over the past winter he cooperated in obtaining fresh specimens for Dr. T. Tamura, a visiting Japanese scientist who spent six months at The Marine Laboratory studying the vision of pelagic game fishes. The results of his work have not yet been published but they should be of extreme interest to anyone concerned with oceanic game fish or fishing.

Although our work has not been concerned with sport fishing per se, several interesting possibilities along that line are readily apparent. One would be deep jigging for amberjack, groupers, and possibly tuna. Another would be deep trolling with an underwater outrigger. The latter method might easily result in catches of swordfish, marlin, or tuna if given a fair try. Often in the spring of the year large, fast fishes are hooked on the electric reels well above the bottom. Invariably they break off or become unhooked. Several baits recovered on such occasions were crushed but not cut, which fairly well eliminates the possibility of sharks.

As a result of this work, the Florida Keys fish program headed by Dr. C. Richard Robins, and the Florida Bay survey by Durbin Tabb, the fish fauna of the Florida Keys is perhaps now the best understood of any comparable tropical area in the world. However, the job is far from complete and we plan to continue all phases of the work in the future.

ECOLOGY OF EGGS, LARVAE, AND YOUNG OF GAME FISHES IN THE CHESAPEAKE BAY

Presented by

Romeo J. Mansueti

NATURAL RESOURCES INSTITUTE
UNIVERSITY OF MARYLAND
Solomons, Maryland

at the Sixth

INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida

November 15, 1961

ECOLOGY OF EGGS, LARVAE, AND YOUNG OF GAME FISHES IN THE CHESAPEAKE BAY

by Romeo J. Mansueti

Natural Resources Institute
University of Maryland
Solomons, Maryland

Chesapeake Bay, one of the largest estuarine systems in the Middle Atlantic bight, is an extremely important spawning, nursery, and growing area for a wide variety of game fishes. It is a drowned river valley of the Susquehanna River with a dendritic pattern that drains a broad and rich agricultural area of the mid-Atlantic states. Its comparatively rich productivity is enhanced by a two-layered system that is characterized by a surface layer of fresh water, with a net downstream movement and a bottom layer of very dense salt water with a net upstream flow. When the action of the two-layered system is combined with the tidal cycle, nutrients are trapped and efficiently metabolized in the mid-estuary where phytoplankton and zooplankton are available for grazing by larval and young fishes. In general, Chesapeake Bay and its tributaries are relatively free of widespread industrial contaminants, but as far as fish eggs and larvae are concerned, silt, detergents, pesticides, and some domestic pollution continue to pose great problems.

Eggs, larvae, and young of game fishes using Chesapeake Bay may be classified as follows: (a) resident spawners more or less restricted to tributary rivers or the Bay on a year-round basis (the striped bass as a coastal migrant is an exception); (b) anadromous spawners originating from outside Chesapeake Bay during late winter and spring months; (c) planktonic eggs and/or larvae and young entering from the mouth or outside Chesapeake Bay during every month of the year; and (d) accidentals, which include freshwater and marine species that involuntarily come into the Bay.

Resident spawners, principally striped bass, perches, as game species are limited in number compared to the greater number of non-game species (which, nevertheless, are ecologically important). The game species, in descending order of angling importance, include: striped bass, Roccus saxatilis; white perch, Roccus americanus; yellow perch, Perca flavescens; chain pickerel, Esox niger; channel catfish, Ictalurus punctatus; walleye, Stizostedion vitreum; pumpkinseed, Lepomis gibbosus; carp, Cyprinus carpio. All spawn in tidal fresh or slightly brackish water, and only the striped bass produces pelagic eggs. The others deposit demersal or semi-demersal eggs. The spawning areas for many of these species have been greatly affected and somewhat reduced by sedimentation, dams, and localized pollutants. The extensive population growth of carp suggests important problems of interspecific competition on the spawning grounds. Some of the residents undertake large intra-estuarine runs.

Anadromous spawners, mostly shads and herrings, comprise a few species but produce extensive seasonal abundance. Two species are important to anglers: American shad, Alosa sapidissima; and hickory shad, Alosa mediocris. These clupeoids spawn in tidal fresh water, and deposit semi-demersal eggs. Their early developmental stages are an important part of the zooplankton of the upper and mid-estuaries during the spring. Although many young leave the Bay in autumn, some over-winter. Spawning areas of these fishes have been seriously altered or reduced by man.

Planktonic eggs and/or larvae, many in the croaker family, are brought into Chesapeake Bay by the subsurface layer of dense sea water having the net upstream flow during the tidal cycles. The species thus far identified include, in descending angling importance: Atlantic croaker, Micropogon undulatus; weakfish, Cynoscion regalis; spot, Leiostomus xanthurus; red drum, Sciaenops ocellata; black drum, Pogonias cromis; bluefish, Pomatomus saltatrix; black sea bass, Centropristis striatus; tautog, Tautoga onitis; summer flounder, Paralichthys dentatus; winter flounder, Pseudopleuronectes americanus; scup, Orthopristis chrysopterus; and American eel, Anguilla rostrata. Since Chesapeake Bay is at the northern end of the spawning range for most of the sciaenids, there are considerable fluctuations in the availability of larvae and young. This is further reflected in serious declines in the availability of croaker and weakfish to all fishermen in the Bay. The eggs for many of the above-listed species are unknown, although the small size of prolarvae found in the Bay for some species suggests that they spawn immediately outside in the Atlantic Ocean. Although the Atlantic menhaden, Brevoortia tyrannus, is not a game species, it is important in the movements and feeding of predatory fish in Chesapeake Bay. Its early developmental stages follow the same sequence of movements as many of the species above. Most of the species use the estuary as a nursery as they drift downstream to sea in the free-swimming stage. They virtually all vacate the Bay by the end of October and early November.

Accidentals, i. e. species not normally in the estuary, include a wide variety of freshwater river and strictly marine species that enter during their early stages through the aid of unusual hydrographic and meteorological phenomena. Freshets wash in stenohaline freshwater species, while unusual winds, tides, and other factors may bring pelagic and semi-demersal eggs and larvae from far offshore. Very young, free-swimming carangid fishes are examples of the latter.

The forces of the two-layered estuarine system in Chesapeake Bay exert profound effects on the fate of eggs, larvae, and very young fishes. The upper layer with its net downstream motion is caused by fresh water flowing in at the head of the estuary. In the process it also carries salt water downstream. This is possible because of the progressive transfer of deeper, higher salinity water from the lower layer upward.

Thus, this mechanism maintains the salt balance of the layers, and also causes the net upstream flow after the oscillatory tidal motion has been averaged out. The subsurface return current can carry fish larvae in deep water from the Bay entrance to a point 130 miles upstream in less than 20 days.

Summer is a dangerous time for demersal and semi-demersal stages brought into the mid-Chesapeake Bay. Natural conditions produce depleted dissolved oxygen conditions in deep water, and if they remain there, high mortalities would result. Most larvae and young frequent shoal water or stay far upstream in estuaries when low oxygen conditions exist. During other seasons, however, oxygen is normal in deep water.

The striped bass is preadapted to highly turbid water because of its highly buoyant eggs. The species with semi-demersal eggs are less favored by such conditions, but those producing demersal eggs, especially those that are adhesive, such as white perch and walleye, are at a great disadvantage in such situations. The swift-moving waters which frequently occur in spring months after rains are beneficial to all species. They transfer the early stages to the brackish areas where salinity neutralizes and precipitates the negatively-charged suspended particles. Here turbidity is reduced, light penetration is optimal, and photosynthesis by phytoplankton creates an extremely productive grazing area for zooplankton.

The reduced carrying capacity has been slightly offset by increasing mineralized fertilization from treated domestic wastes in the Chesapeake watershed. The reduction has resulted from sedimentation, wetland reclamation, and industrial contaminants. Two additional dangers threaten future spawning success of game fishes: (1) waterflow control by reservoirs in the upper watersheds, which may seriously alter the circulation, flushing, and tidal patters; and (2) the remote possibility of accidents at nuclear-powered plants along river banks in the Bay's watershed and radioactive waste disposal areas at depths where certain species produce eggs and larvae that find their way into Chesapeake Bay.

GAME-FISH RESEARCH IN PANAMÁ, COLOMBIA, AND ECUADOR, 1961

Presented by

Donald P. de Sylva

INSTITUTE OF MARINE SCIENCE
UNIVERSITY OF MIAMI

at the Sixth

INTERNATIONAL GAME FISH CONFERENCE

Miami Beach, Florida

November 15, 1961

GAME-FISH RESEARCH IN PANAMÁ, COLOMBIA, AND ECUADOR, 1961

by Donald P. de Sylva

Institute of Marine Science
University of Miami

The Eastern Tropical Pacific is extremely interesting to the marine biologist because of its rich fauna and because of the relatively few opportunities which have been afforded scientists to work in its waters. The animals and plants of that region continue to be a source of important material for the specialist working on tropical species. Each time a collecting trip is made into the area, new and rare species are described, and zoogeographic problems unravelled.

While systematic studies, including proper names and identifications of the animals involved, are basic to any biological studies, often of greater interest to the sport fisherman and amateur oceanographer is the study of the life history, migrations, and general biology of marine animals. Of particular interest are the myriads of large fishes found in the Eastern Tropical Pacific which have been virtually untapped by sport-fishing interests. Too, this area is a rich source for potential commercial fisheries exploitation. The deep waters and the abundance of game and bait fishes frequenting the islands, harbors, bays, reefs, and open ocean make this a likely source of exploitation for the fisherman in the future.

The Institute of Marine Science of the University of Miami has been interested in this area for a long time because a number of tropical species in the Caribbean are closely related to those of the Eastern Tropical Pacific. Because of a relative lack of knowledge of these animals to science, and also because of the abundance of game fish in the area, Mr. Alfred C. Glassell, Jr., of Houston, Texas, has also had a long-standing interest in this region. Thus, it was natural for Mr. Glassell to want to investigate the scientific aspects of these fishes and other tropical organisms of the Eastern Pacific, and to support an expedition to this region in 1961. Mr. Glassell, a world-renowned sportsman, is holder of the world-record, 1560-pound black marlin, taken off Cabo Blanco, Perú. He has caught hundreds of marlin in all parts of the world, but the marlin and the fishing off the northwestern coast of South America still hold perhaps the most exciting challenge to him and to other sport fishermen.

The purpose of the trip was to obtain information on the animals of the region, particularly the billfish and other game fish including the snappers, tunas, barracudas, jacks, dolphins, and sharks. We wished to obtain reef forms from the rich coral areas which have been insufficiently studied. Also, the purpose of the expedition was to obtain as

much ecological data as feasible in a limited amount of time. This was accomplished by collecting hydrographic data at stations primarily located off the coast of Ecuador; wherever possible, limited data were collected in other parts of the coast. But because the vessels involved were not specially outfitted for such work, the work was generally limited to biological collecting.

The major collecting methods involved SCUBA gear using spears of various sizes, fish poison (rotenone), and fine-mesh collecting nets. Dives were made to depths of 120 feet, but most collecting occurred at less than 90 feet. We felt that the diving operations were particularly important because SCUBA gear had never been used in this area to collect specimens. In addition, the vessel Argosy, a 107-foot diesel ketch, was utilized for trawling, dredging, plankton tows, and night-lighting using dip nets. The 40-foot sport fisherman Sea Quest was used to capture the larger game fish, using hook and line in surface and deeper waters. The Sea Quest, captained by Red Stuart, was highly successful in its search of these fish for scientific study, while the Argosy, under Captain Arved J. Rosing, was used as a mother ship from which the scientific crew made most of its collections. Wherever the vessel stopped, gill nets, trot-lines, and fish traps were set in order to obtain a variety of animals. The most successful collecting method was with the use of SCUBA gear, but many interesting collections were made using hook and line and trawls.

Five of the seventeen individuals of the scientific expedition were scientists. On the Argosy, there were seven crew members while the Sea Quest was crewed by three.

Preparation for the cruise began about June, 1961 and was continued through the time of shipment of the material to Panamá on August 15th. On August 5th, the scientists joined the two vessels in Balboa. After a brief preparation and completion of final arrangements, the cruise got under way on September 7th.

The vessels left for the Perlas Islands where angling was done in route here as well as throughout the trip. The coast of Panamá is a well-known area to sport fishermen. Pacific waters are famous for yellowfin tuna, sailfish, striped marlin, snapper, dolphin, groupers, and jacks of various kinds. Most Pacific sails run quite large, averaging about 90 pounds, in contrast to the smaller Atlantic form. It is not known at present if these two forms are the same species, but research underway by Dr. C. Richard Robins at our Institute should solve the problem.

During the running of the vessel, we towed a high-speed plankton sampler behind the boat. This sampler, constructed of aluminum, has an opening of about 2 inches and contains a fine-mesh screen. We were particularly looking for larval fishes, and we were successful in

capturing larval tunas, dolphin, jacks, snappers, and other game fish, in addition to many other interesting fishes and invertebrates using this sampler and other types of plankton nets. Unfortunately the high-speed sampler was eventually lost when it hit a 30-foot log.

Along the Panamá coast large schools of anchovies are fed upon by gulls, petrels, frigate birds, and boobies. These concentrations of birds are important to anglers in indicating areas of good fishing. During the cruise between the Panamá mainland and the Perlas Islands, several small schools of dolphin (Coryphaena) and rainbow runners (Elagatis) were indicated by flocks of feeding birds. At the Perlas Islands, we went ashore and collected in the tidepools and in the heavy surf. Here we took juvenile forms of pompano (Trachinotus rhodopus), as well as anchovies on which pompano had been feeding. In the tidepools were a number of young stages of many of the reef fishes which drift inshore and grow up in these pools.

Here as well as in other places one of the most successful collecting methods for land animals and birds, which were also a target of the expedition, was with the use of a BB gun. It was possible to collect many unusual forms of crabs, lizards, and birds using this simple but effective method.

Fishing was excellent in the harbor at Santelmo Bay in the Perlas Islands. Some of the crew and scientists fished, while others placed waterproof lights over the side to attract fish so that they could be scooped from the water with dipnets. We were surprised to find one of the lights surrounded by seemingly hundreds of chubs, (Sectator ocyurus). This supposedly rare form was previously known only from three individuals in the world, yet here were clouds of this species surrounding the light and blocking it from our view. Many of these were taken on hook and line and some preserved for study. Barracuda (Sphyraena ensis?), several species of jacks, grunts, snappers, and groupers were taken in this area.

The following day, the vessels departed for Piñas Bay, and handlines were put over the sides for trolling. Rainbow runners, yellowfin tuna, oceanic bonito (Katsuwonus pelamis) and black skipjack (Euthynnus yaito) were taken en route. Mr. Glassell, fishing from the Sea Quest, was successful on smaller species, but was less successful in taking billfish. Piñas Bay is also a famous fishing spot. It is a deep embayment, with blue water close to shore. We were told by natives who were familiar with the sport fishing in the area that large yellowfin tuna and even sailfish entered this small, deep bay. During our stay there, we saw numerous sierra mackerel (Scomberomorus sierra), about 3 to 5 pounds. These traveled in large schools and were abundant throughout the coastal area of Piñas Bay. Here again, many chubs surrounded our night lights and many other small fishes were attracted

which in turn attracted large jacks. These jacks were African pompano (Alectis sp.), and several different kinds of jacks of the genus Caranx, some of these ranging from 5 to 15 pounds. Angling was carried on for specimens for study, wherever possible, using very small hooks. Snappers, chubs, grunts, and a number of small reef forms were taken. Trawling, carried out at night from the small launch, yielded large numbers of small snappers and flounders which apparently utilized the shallower areas of Piñas Bay as a nursery ground. Noticeable to us at least was the presence of a number of species which are considered Indo-Pacific. This was particularly true of the pelagic forms such as the jacks and larger reef fishes, which we had thought to be uncommon in Panamá waters; and throughout our dives along the west coast of South America we observed many species, some in rather large numbers, previously throught to be rare or absent from these waters.

At the southernmost cove of Piñas Bay, a long sandy beach with some surf was selected as a collecting spot. Using a 60-foot bag seine, we obtained numerous herring and anchovies, which are fed upon by a number of the larger predatory fishes. This beach also yielded several members of the croaker family, common on such sandy beaches. On one side of the beach, a tidal estuary fed into the mouth of the Bay. In this estuary, poison stations yielded young stages of flounder, snappers, mullet, and adult puffers, as well as a number of young and adults of other fishes.

Concerning deep-sea fishing, angling for the billfish was not profitable at this time; but anglers in the past have done well here on large specimens of striped marlin, sailfish, black marlin, dolphin, yellowfin tuna, bonito and skipjack. On the reefs offshore, large grouper and snapper are abundant, as well as a wide variety of common coral-reef fishes. A number of large carcharhinid sharks were taken off Piñas Bay. One large shark weighing 325 pounds was identified as C. commersonni. Several mako or bonito sharks (Isurus glaucus) were seen, and one was captured weighing 325 pounds. The stomach of this specimen contained several well-digested spines of the caudal fin of a sailfish or marlin. Several other sharks were taken also believed to be C. commersonni. One black marlin was seen, and a sailfish 89 inches long was taken.

Several diving trips to the islands about Sentinel Rocks just outside of Piñas Bay yielded a number of good poison collections, but our efforts to collect were somewhat hampered by a large number of whitetip sharks, which we believed to be Carcharhinus albimarginatus. These ranged from about 3 to 6 feet long, and kept close to the divers, although we had no actual problems other then in our minds. At one point, a large manta ray was seen. Of interest in this area was the presence of turbid water to a depth of about 60 feet where a visual

thermocline was noticeable. Below this, the waters were crystal clear and teeming with reef fish at greater depths.

On September 12th, the vessels departed for a sea mount, a submerged ridge reported to be about 40 miles off Piñas Bay. This sea mount is a rise indicated from several hundred fathoms to a depth of 40 fathoms, and we attempted to locate this and to anchor the Argosy on the reef. In transit, we continued our trolling and produced yellowfin tuna ranging from 10 to 20 pounds, skipjack, and rainbow runner. A large number of wahoo (Acanthocybium), yellowfin tuna and black skipjack were taken by the Sea Quest. Stomach contents of these often revealed large numbers of anchovies, stomatopod larvae, and tuna-like fishes, which were believed to be of the genus Auxis. We are uncertain if we actually located the "Sea Mount" but probably came quite close to it. It was the captain's belief that the mount is incorrectly located on the chart. Tuna fishermen from the United States fish over banks to the north similar to this one and catch large quantities of yellowfin tuna and skipjack. The importance of ridges such as this are well known to fishermen and to scientists as being very rich in tuna and billfish. That we were in close proximity to this reef was indicated by the abundance of big fish in the area and large numbers of bonito, skipjack, wahoo, and dolphin. A few billfish were seen but none was hooked during this trip. Large dolphin were taken in this area, all of which were Coryphaena hippurus. During the trip to the sea mount, many flyingfish and porpoises were observed, and the waters were generally rich in organisms. Plankton tows and night-lighting carried out from time to time continued to yield rich quantities of fishes. We took the young stages of several of the tunas, but they have not yet been identified.

At night, in the vicinity of the night-light, we put out shark lines baited with large chunks of bonito, and caught ten sharks from 3-1/2 to 7 feet, which we identified as Carcharhinus porosus. However, the identification of these is uncertain. Eventually, about 40 of these were taken. There were a number of sharks in the area and these could be seen just outside of the ship's lights or the night-lights. However, as soon as the light was placed in the water, the sharks were attracted, and made frequent passes back and forth and seemed to become frenzied. When the pieces of bonito were thrown overboard, there were no preliminary passes or hesitation; the sharks made a bee-line for the bait and took it immediately. However, after several sharks were landed, the others became somewhat more wary although they still continued to take the bait. It was a simple matter to put a chunk of bonito on a shark hook and catch one. These sharks were played for a short time on a heavy line and brought within range of the boat so that they could be shot with a .30-caliber rifle. They were then landed on the deck, dissected and examined. Sharks around the Argosy were quite frenzied, and a pyramidal trap put over the side and baited with bonito was torn to shreds by the sharks.

At this sea mount we took a number of very small dolphin, (C. hippurus) which were attracted to the night lights, as well as a number of deep-sea myctophids, gempylids, flyingfish, and squid. We obtained here 11 small billfish ranging from 7 to 9 inches, which we believe are either sailfish or striped marlin. Definite identifications have not yet been made.

On September 15th, we departed for the Colombian coast at Bahía Solano. As before, we trolled lines from the stern of the vessels and obtained skipjack, bonito, rainbow runner, and yellowfin tuna. The stomachs of all of these were examined for small billfish and tuna, but only tuna-like fishes, jacks and large plankton organisms were found.

Bahía Solano is a beautiful, tropical rain-forest habitat, with high mountains and lush greenery. A number of waterfalls cascade down the mountains into the Bay, which is deep throughout its length. Close to shore a number of rocks harbor grouper, snapper, and large jacks which were taken by various methods including spearing, poison, and hook and line. Some angling was done offshore, and black marlin were reported but none was taken at this time. Striped marlin were seen and several sailfish were caught. According to the fishermen, there were many large groupers, snapper, and jacks in the bay. Occasionally sierra mackerel and tuna enter the mouth of the Bay. We believe that the future of sport fishing should be excellent in this area.

On the evening of September 16th, we departed south toward Buenaventura, Colombia. Surface temperatures taken en route did not reveal any substantial change in water temperatures but data have not yet been completely evaluated. En route, a number of trawl collections were made from the Argosy revealing large concentrations of commercial-size shrimp, crabs and flounders; the flounders resemble our northern fluke. A number of other smaller types of flatfish (Soleidae) were observed, but were too small to be commercially valuable. Just northwest of Buenaventura we obtained a number of young stages of sierra mackerel in the plankton net, as well as the young stages of flyingfish and African pompano.

At Buenaventura we spent several days refueling and obtaining provisions. It was here that we took aboard three Colombians including Mr. William Saenz, a former employee of the University of Miami, and Dr. Luis Ortiz Borda, a faculty member of the Universidad Lozano Tadeo, Bogotá. These gentlemen accompanied us on our trip to Gorgona Island, located southwest of Buenaventura.

On September 20th, we left for Gorgona Island. This leg of the trip was noted for its relative scarcity of birds which had been seen in some numbers to the north. Gorgona is a beautiful steep island covered with lush vegetation. Being the site of a penal colony, we

were concerned about diving operations in these waters, but we received the complete cooperation and safe passage from the Colombian Government. Reports in this area had indicated that the region was surrounded with sharks, but we saw relatively few of these. Other reports came to us that a 240-pound and a 190-pound Pacific sailfish had been taken in this area. Unfortunately we have been unable to track these down. Fishing for marlin in the area, as well as sailfish, was superb. Mr. Glassell hooked a black marlin which he estimated at 600 pounds and landed a small black marlin weighing 325 pounds. Also, sailfish and yellowfin tuna were abundant off here, and we saw a number of bonito feeding close inshore where we were diving. A 250-pound whitetip shark was also brought in containing two rainbow runners in its stomach. At night, angling produced ladyfish (Elops), jacks (Caranx spp.), and African pompano. As in other areas, specimens obtained were preserved for study and identification. Many of the fish taken at our anchorage (about 110 feet deep) when hooked were taken by sharks. On the reefs were many different kinds of snappers and groupers, as well as jacks, some sharks, and bonito. The rich coral habitat around the island provided an excellent cover for many of the brightly colored reef-fishes such as angelfish, snappers, butterflyfish, grunts, blennies, gobies and squirrelfish; the latter seemed to be present in the greatest numbers we had seen to date. Using spears, poison, and hook and line, we obtained some of our best collections of the trip from this area.

On September 24th, toward Tumaco, Colombia, we saw a number of flyingfish en route, but no tunas were taken at this time by trolling. The coastal approach to Tumaco is covered with a heavy mud buttom mixed with sand and debris. Over this bottom we trawled up a good collection of shrimp, flounders, sand perch, searobins and puffers. Our best trawl collections were taken in these mud - debris habitats. Between the inland area of Gorgona Island and Esmeraldas, Ecuador we were in shallow, muddy water, and few gamefish were observed en route. Some angling was done offshore by the Sea Quest, and large schools of skipjacks were encountered although no marlin were seen. However, at Esmeraldas, the native fishermen trolling or drifting large bonito from bongo dugout canoes had taken four large black marlin and a striped marlin; and three Pacific blue marlin weighing about 300 to 450 pounds were seen in the market. Also common were yellowfin tuna, skipjack, bonito and wahoo which were caught in local waters. In another part of the market, many fish were purchased including bonefish, which seemed to be quite common, eight or 10 different species of croakers, and an unidentified species of barracuda. Pompano, flounder, jacks, and a small hammerhead shark were also purchased from the market.

On September 26th, we approached Manta, Ecuador and encountered large schools of oceanic bonito under way. At Manta, Van Camp Seafood Company maintains a large fishery and cannery for oceanic bonito. Approximately 12,000 tons of bonito are canned per year, and these fish are taken between Esmeraldas and Salinas, Ecuador. Most fishing is done

by hook and line (jackpole fishing), but purse seines will be tried in the future.

The coastal area, beginning at Esmeraldas, was semi-arid and in complete contrast to the Colombian and Panamanian coasts; and Manta was extremely arid, virtually devoid of vegetation. The coastal plain from here south to central Chile is essentially as at Manta.

On September 28th, we arrived at La Plata Island, Ecuador. This is an arid island roughly similar in shape and size to Gorgona, but lacking the beautiful, tropical greenery of Gorgona. The island is high and rugged, and slopes off deeply to about 20 fathoms very close to shore. This is the site of perhaps one of the world's largest commercial marlin fishing areas, although this is largely seasonal and apparently dependent upon local wind and ocean-current conditions. Along the eastern side of the island, there are extensive tidepools exposed at low water but on the western side of the island it is buffeted with heavy surf resulting in a highly eroded shore line. Our shore collecting was limited to the leeward side of the island because of the island because of the difficulty of collecting on the windward side. Considerable angling was done by the Sea Quest in this area, as well as by the crew of the Argosy at night.

Many sailfish, striped marlin, and small black marlin were taken here, although no large black marlin was seen at this time. These were taken west of the island and far offshore. Smaller fishes included wahoo, which were very common throughout the area and ranged from approximately 20 to 50 pounds, schools of bonito, and skipjack. On September 30th, evidently due to a current shift or change in food organisms, a large school of true bonito (Sarda) was found off La Plata. This was the only day on which these were caught, and by the following day, the other bonito (Euthynnus and Katsuwonus) returned to the area in large schools.

A large number of large amberjacks (Seriola dorsalis?) were observed in depths as shallow as 40 feet during diving operations. Some of these fish were estimated in excess of 60 pounds and one fish perhaps approached 100 pounds. These were quite tame and approached us very readily. When we asked the natives if they caught them, they claimed they did not know what they were when we described them and showed a specimen to them which we had speared. There were also large numbers of several groupers (Epinephelus, Mycteroperca), chubs, and the usual brightly colored reef fishes, common throughout the rocky reefs. Several species of snappers were also taken by poisoning, spearing, and hook and line. Jacks of various genera were common in the area and perhaps the most abundant was the horseye jack (Caranx latus), although the crevalle (C. hippos) was also common there. Although none was taken east of La Plata Island, roosterfish (Nematistius pectoralis) are common along the mainland in the vicinity of Salango Island and to the south, as well as being reported from the

western shore of La Plata Island. Barracuda (Sphyraena idiastes?) were taken in some numbers around the island by us, as well as by commercial fishermen. At times, we were told that large schools of yellowfin tuna moved into the area and could be taken in beach seines. As in the area of Gorgona Island, the steep shore permits oceanic fish to come in very close. Mr. John A. Manning reported to us prior to the expedition that during his work at La Plata in 1954-56, he encountered large marlin and sharks within a hundred feet from shore. However, the natives were in agreement that the fish had not yet appeared, and that the larger fish which were expected in the area simply had not yet shown up. We were told that these fish moved in on approximately a 28-day cycle according to the currents and winds. Preliminary hydrographic studies suggest that the currents of the area are probably extremely important in determining the movements of the pelagic fishes of the area, but a final report on this has not yet been made. The Food and Agricultural Organization of the United Nations, as well as the Inter-American Tropical Tuna Commission are studying the tuna and the hydrography of this area, and presumably will make a detailed report on these waters.

Much diving and poisoning was done on the reefs in the area. We obtained juvenile stages of many snappers, groupers, and other reef fishes as well as many invertebrates, some of which we believed to be undescribed and many of which were rare. We worked a number of different ecological habitats all over the east side of the island and obtained a good representative collection. Almost every night while at La Plata, we hung a light over the side and used dip nets to attract the fish and invertebrates. We obtained many different kinds of fishes and invertebrates including eels, flounders, squids and octopods, blennies, and many crustaceans. We also trawled, set gill nets, trot lines, and angled wherever possible.

Clearly, this can only be a preliminary, very sketchy account of our operations. The slides shown during this talk gave some indication of the habitat observed during the trip and the colors of the fresh specimens of fishes and invertebrates collected. The expedition, we feel, was a tremendous success, and we obtained over 300 gallons of fishes and invertebrates. Presently these specimens are housed at the Institute of Marine Science of the University of Miami and some are being shipped to specialists who will identify these and describe any new specimens taken. This is perhaps the most difficult part of any expedition. The plans then are to return the manuscripts of the results to the University where they will be edited and published as the Alfred C. Glassell, Jr. - University of Miami La Plata Expedition. Although this expedition by no means was comprehensive, we did have an opportunity to collect intensively in a few areas during our six-week period using SCUBA gear and several other types of gears which had not been used in that area before. By using such specialized gear and trained diver-scientists, we believe that we have been able to produce interesting and valuable information for the field of marine science.

In conclusion, the personal interest and financial support of the expedition and the forthcoming publication of the results speak as a tribute to Mr. Glassell. The scientists and crew members gratefully express their appreciation to him. We also wish to thank the Governments of Panamá, Colombia, and Ecuador; and their respective consuls in Miami, Sr. Manuel Castillo, Sr. Mario Iragorri, and Sr. Jose Chiriboga, who were instrumental in obtaining necessary permission from their countries for scientific operations. Special thanks are also due to Mr. F. Bourgois, National Fisheries Institute, Guayaquil, Ecuador, for making further arrangements for our operations.

DISCUSSION SESSION

Dr. F. G. Walton Smith, Discussion Leader

November 15, 1961

HOW CAN ANGLERS AND SCIENTISTS COOPERATE? AN ANGLER'S VIEWPOINT
Nelson Benedict

Benedict: Earlier in the discussion, beef and poultry were mentioned as major sources of protein; actually, fish are major sources of protein in our wasteful economy. Fertilizer made from fish is reduced to scrap and meal for poultry diet, and hog and beef supplements. Nations not having a beef economy, such as the Japanese, take their protein directly from the sea. The time may come when it may be prohibitively expensive to maintain our agricultural economy, which is predicated on fish life, where we may have to bypass our meat and take our protein directly from the sea.

The second point I wish to bring up is that in New Jersey, twenty-two Russian catch-boats and two mother ships are fishing on our continental shelf. They have fished large populations of fishes from George's Bank southward, all winter long. Many of these are frankly interested in hydrographic information and make no pretense of fishing; others are actually fishing. They are longlining and deephole dragging to 200 fathoms in some instances, which to us is unbelievable. They have convinced us that the Russians are out to gain complete control, or become the No. 1 fishing nation in the world until they surpass even the Japanese.

We have had two Japanese boats longlining off New Jersey all summer from the Dominican Republic. The Japanese have demonstrated a remarkable interest in billfish, and we discovered why. They are manufacturing a sausage of marlin meat, which they like because it jells and is easy to render into sausage form. Thus, all of our conversation about managing certain species of fishes becomes academic in the face of this new pressure. Where the Russians who will not apparently subscribe to any convention, including the Grand Banks or the Bering Sea salmon fishery, are entering into this picture with the most modern fleet of fishing vessels in the world, they are and will be fishing on our continental shelf. And we are most concerned, because many of our groundfishes, such as the summer flounder, porgy, and sea bass, winter not to the south but to the east, namely, along the edge of the shelf. An emergency meeting is being held in New Jersey next week to discuss how to cope with this problem, and obviously there is no real answer to it because the operations are well beyond the three-mile limit, and must be settled by international convention. Fortunately, such species as sea trout and striped bass are not concerned with this operation, but we are dramatically and dynamically concerned with what will happen to ground fishes now that the Russians

have entered this picture. We think that there is an excellent chance that some of these fish will be extirpated by overfishing. Our New Jersey biologists for years have been telling us that the summer flounder fishery is on the verge of ruin; 25 per cent tag returns indicate a great and overwhelming recapture of fluke-of-the-year. If there were to be a failure of fluke spawning, this entire fishery could die overnight; and this is a fishery which is substantial and recreational. We saw these boats as recently as two weeks ago, and their techniques are modern and effective. For the deep-sea fishes which winter on the ledge of the continental shelf, it will cause us to revise our entire thinking on conservation and management.

William Meyer: Are they getting blue marlin?

Benedict: The Japanese had one mother ship and six catch-boats for longlining, and they were taking swordfish and marlin. Also, the Norwegians had two flagships which were longlining for swordfish in that area. These longlining techniques are so effective that the fishery will probably be intensively fished by perhaps next year.

Ann Kunkel: Do these fishermen use rod and reel to catch marlin?

Benedict: I refer you to Dr. Smith.

F. G. Walton Smith: This is a fairly extensive fishery involving hundreds of hooks fishing at various depths. It is a very efficient type of fishing.

SOME MARINE SPORT FISHERY PROBLEMS
Richard H. Stroud

C. Richard Robins: Is the Sport Fishing Institute more interested in applied research or basic research?

Stroud: We can say that we are much more interested, generally speaking, in supporting long-term basic research, and we generally follow the definition which is used by the National Science Foundation. If we have to make a distinction between the two, I think that we can say that we are more interested in supporting basic research than applied research. I would like to cite the example of the research on striped bass, carried out by Dr. Edward Raney, which began as a basic study involving counting the number of fin rays of striped bass up and down the coast. At the time it did not seem that practical results might be realized, but this study brought out many fundamental facts which led directly to racial identifications of the stocks, which has ultimately proved to be a useful tool for a coast-wise coordinated striped bass research program.

Robins: Can you discuss the problem which is being presented by the use of monofilament nylon for fishing?

Stroud: This is caused by the persistence of monofilament line which is broken off in a fish, and perhaps can cause real trouble. This was brought up recently during our Board of Directors' meeting as being a real coming problem. There is no solution in sight at the moment, but our president, Henry Shakespeare, suggested that perhaps monofilament line could be devised which would dissolve after a period of time, perhaps after seventy-two hours in the water. It has been recognized as a problem, but this is all we can say at the moment.

Joseph Penfold: Mr. Stroud this morning mentioned the controversial question of salt-water fishing licenses, and I would like to get an impression from the Sport Fishing Institute as to their feelings about it. The Izaak Walton League supports the idea in principle in that this is a practical and necessary way of raising funds to do the basic research so that there can always be a group of people who will have a chance to go fishing, such as the thirty, or forty, or fifty million Americans.

Stroud: This is hard to answer, because I have not polled this particular group. The Institute has made some polls in collaboration with the National Wildlife Federation which has passed a resolution endorsing this proposal and principle, as has the Izaak Walton League. People who are opposed to this idea challenged it on the basis that it reflected "inland" thinking. We undertook to locate as many of the individual clubs in the coastal states as possible and sent them questionnaires asking what they thought, thereby eliminating this alleged inland dominance. About 90 per cent of the 1,400 clubs from whom we received replies indicated they were in favor of salt-water programs, research, and development. But when it came to the actual question "Do you favor a salt-water license?" most of them had no opinion. About 20 per cent said that they were opposed to it, about an equal ratio favored it just as strongly, and the rest of them took the attitude that they did not know, but whatever was needed to raise the funds they were for. This corroborated what we had received from the previous survey done with the National Wildlife Federation where the sentiment was that we need these funds and the people concerned should come up with appropriate means for raising the funds and that this should be supported. I recall particularly the comment of a Louisiana club which indicated that the average U. S. sportsman would pay for value received. In other words, if there was a good program presented to them and could see where the money would go, they would probably support such a program and the means for raising the funds. We offered these clubs the opportunity to suggest alternate means of financing, and none of them had any that amounted to anything, or that were feasible. At the same time there was unanimity of opposition against the Federal license as such, not only from the sportsmen's group themselves, but from the state agencies with three

exceptions, which were I think from the state agencies.

Smith: I think that this is a matter of political philosophy. The question is personal, of whether the user should pay or whether everyone should pay or whether the angler should pay for what he gets out of research, or everyone should whether they fish or not. This is a question of political philosophy that, to my knowledge, has not been solved in any area of taxation in this country. I would like to say, however, the fact is that bait and tackle manufacturers themselves have taken the initiative in supporting research, and this is a rather impressive thing to me. If the bait and tackle manufacturers are prepared to put some money into research, is it not possible that even the anglers themselves might be prepared to put some money into research in the form of a license? Of course, the moment they do that I think they are entitled to say how this money should be spent, and logically it probably should be spent to insure that they have more fishing and not to determine scientific facts for the pleasure of biologists. But I do want to take the opportunity to thank Mr. Stroud for being here and to compliment the bait and tackle manufacturers on the step they've taken to support research on game fishes.

Stroud: Thank you, Dr. Smith. I would like to add just one thing--our organization was initiated by the fishing tackle manufacturers. The support has been broadened, and we now receive funds from other segments of what we call the sport fishing industry, outboard boats, and motors. We are getting some oil money, and hope to get more in the broad panorama of sporting goods. But now we are able to draw on a little broader support base which we hope will increase each year.

MARINE FISHERY RESEARCH SPONSORED BY SPORT FISHING INSTITUTE
Robert M. Jenkins

Jenkins: Mr. Richard Wade informs me that the movie he prepared on the Biscayne Bay research was shown at the conference last year, but I personally would like to have it shown at the end of this session.

NOTES ON TAGGING FISH ALONG THE SOUTHWEST COAST OF FLORIDA
Robert F. Hutton, Robert M. Ingle and Robert W. Topp

N. J. Brown: Dr. Hutton spoke this morning about only larger fish being tagged in this program, yet I believe that a large prize was won for catching a six-ounce fish. Could you explain this?

Hutton: Both the State Board of Conservation and the Game and Fresh Water Fish Commission did tag the fish, but they tagged smaller specimens than we did, and this one happened to be a fresh-water species. This was in the Schlitz contest, but it was both the State Board of Conservation and the Game and Fresh Water Fish Commission.

Smith: Do you anticipate extending this program?

Hutton: The program will be continued and amplified during the 1961-62 year.

Smith: Do you concentrate the tagging on a few species of fish, or do you intend to extend it to cover all fishes you can possibly get tagged? In other words, do you have some underlying pattern for this?

Hutton: Yes. One of the reasons for this, as far as the State Board of Conservation is concerned, is that there are many species that we know little or practically nothing about which are essential prior to population studies.

Smith: I can see great possibilities in having a continuing tagging program in a state like this with a tremendous amount of building activities, with the associated dredging and filling and so on. And I imagine you may eventually get out of this program some very good information on the effects of all this real estate development.

Hutton: This is a critical problem, especially in the Tampa Bay area. Boca Ciega Bay especially has been subjected to this since the early 1950's, and we have seen more there than probably in any other place in the state during that time. We are highly concerned with this, and the State Board of Conservation is mildly interested in it. We have one man who spends practically all of his time traveling around the state investigating bulkhead lines, dredging and filling activities, and recommending to trustees of the Internal Improvement Fund how best to handle it and to mitigate any damage that might be found. The University of Miami cooperates on that in many cases, and such people as Durbin Tabb and Ed Iversen cooperate extensively.

Brown: Are you broadening the range of the species that you are going to tag this year?

Hutton: We intend to tag more reef fishes. Particularly in connection with our artifical reefs which are quite prominent in Florida waters at the present time for fishing clubs, and organizations of that type are interested in creating new fishing areas.

Brown: Will you tag this year, or will only the State Board tag?

Hutton: The problem will be carried out essentially along the same lines. Four or five points are being finished this year which we did not do last year which will improve the program tremendously.

Brown: Have you determined the relative merits of the various methods of tagging and decided on using only one this year, or are you making a variation on that?

Hutton: The tags will be the same as last year, the Petersen and the internal spaghetti tag.

Brown: What determines which tag you will use? The size of the fish, the species or what?

Hutton: Actually, the Petersen tag is used on all other species.

Brown: How is the internal tag inserted?

Hutton: I wish to refer you to Alan Moffett's paper in which he describes the methods of the scalpel slit. There is a high rate of return and little mortality. Our study may show which tags are the best for various species. There are several disadvantages of some of the tags, and we have taken these into consideration.

Brown: I imagine there is a size of the tag to be used in relation to the size of the fish and a certain location for the tag to be placed on the body. I am very interested in the use of the spaghetti tag. Incidentally, has the Schlitz program resulted in any overfishing?

Hutton: Perhaps in the case of the high rate of return for tagged redfish, but probably the program was not carried out adequately to make any inroads on the population. There were a number of deficiencies within the study. There are many pros and cons of the program still to be worked out.

Richard Wade: Will the work be expanded in southeastern Florida zone?

Hutton: The major effort has been expanded in the northeastern part of Florida and southwestern Florida, the zones being indicated as noted in the paper. We tagged relatively few fish in northwest Florida and northeast Florida last year because few taggers were available to assist us.

Samuel Gruber: Is there a possibility of tagging sharks and rays?

Hutton: We have discussed this as a possibility, and I refer you to Bob Topp, who, with his assistant will do all the tagging, measurements, and associated data. We might try "odd species," such as sharks and rays. Incidentally, I might point out that the taggers do not know the value of the tag, but only those knowing it are the Schlitz people.

Unidentified speaker: Has work been done on any sonic tagging devices?

Gruber: Dr. Warren Wisby, of The Marine Laboratory, is interested in tagging sharks with sonic methods, and I refer you to him.

Eugenie Clark: I would like to refer you to Dr. Charles M. Breder's conference on sonic tagging which was held at the American Museum of Natural History in New York.

Harvey Bullis: I believe that it is possible to pick up sonic tags with a radio direction finder at a 1,000-yard range, but the cost of this outfit is quite high.

Smith: Sonic or electronic tags have their limitations, because of the ship's limitations and because one must be very close to the tag in order to detect it.

THE MARINE GAME FISH RESEARCH PROGRAM, BUREAU OF SPORT FISHERIES AND WILDLIFE
Albert Swartz

Lionel Walford: I wish to point out that some cheap plankton meters would be desirable, particularly for mass use for commercial fishing. Dr. Carruthers has designed such a simple plankton indicator which is used by fishermen to show the location of fishing grounds. A simple current meter has been made using a bottle with gelatin and a compass, in which the gelatin solidifies with the compass, thus making a simple meter. Such a program would be of use in the Atlantic shelf campaign similar to that of the American Littoral Society, in which boat owners could use this.

Smith: I would like to call your attention to the International Oceanographic Foundation's Cooperative Research Committee. This has been formed recently in response to the many letters received by the Foundation this year. This type of cooperative work is envisioned by our Committee. This Committee and the participating organizations and individuals could use such instruments as the above and also a simple thermistor device which can register temperature. I have recently seen one for about $5 which will register temperatures down to about 500 feet, and would be excellent for finding the thermocline. While this is not good for measuring temperature accurately, it will probably be quite close. The thermocline is a critical temperature for many fishes, and it would be of interest to put more of these in the hands of the public.

Walford: We have tested this particular thermistor and found it to be accurate to within a degree.

Saul Saila: When will the Bureau of Sport Fisheries and Wildlife reach from their $150,000 to their estimated 2.7 million dollars?

Al Swartz: Congress has authorized this money, but the availability of it depends upon national trends. When the 2.7 million-dollar ceiling is reached, however, we expect that it may be possible to have this ceiling lifted.

Saila: How will this money be apportioned?

Swartz: The exact amount is tentative, but depends upon the national program. We are planning programs in the Gulf and Pacific coasts similar to the Atlantic station at Sandy Hook. We have space available at Tiburon, California which will be brought up to the level of the Atlantic station. Then we expect to have a center along the Gulf Coast.

Frank Mather: What is the geographic definition of the slope area?

Walford: This would be at least to the 100-fathom curve, and we hope that at least a few of the vessels will go beyond this.

Mather: This is a fairly simple definition up to the region of Long Island, but off New England we are covering vast territories in the slope area.

Walford: That is an area covered by the International Commission for Northwest Atlantic Fisheries, by the Bureau of Commercial Fisheries at Woods Hole, and by the Canadian Fisheries Board, as well as ten nations of Europe which are all committed to carrying out environmental and fisheries research in that area.

EXPLORATORY FISHING IN THE FLORIDA KEYS
Walter A. Starck II

Smith: Previously someone asked about the presence of large squid in the area. We know these to be here, and I will call upon Dr. Voss to give some statistics on this.

Gilbert Voss: An 18-foot squid was taken from Fowey Light, a 47-foot squid from the north end of the Bahamas, and two smaller ones have been taken from the Gulf of Mexico.

Webster Robinson: In bringing squid up, do you get any of the little cups on the end of the hooks?

Starck: We only obtain gelatinous material. This is stronger consistency than the jellyfish.

Robinson: We found in Cabo Blanco, Peru, that squid up to 6 feet long will invariably leave the cups from the tentacles on the hook.

Starck: The squid of Peru are different from those here which are not as tough and muscular as those in Peru. The giant squid here would tear through, because of their flabbiness.

Romeo Mansueti: Is it possible that you might have had an oarfish?

Starck: The chunks of bait used were probably too large, but it is of course possible. But I think you would land the oarfish eventually. This is a heavy animal, and when one grabs the cable and lifts it is possible to feel a considerable weight on the other end.

Mansueti: Have skindivers ever seen oarfish in this area?

Starck: Not to my knowledge.

Saila: With modern electrophoretic techniques you should be able to analyze a small piece of this tissue.

Starck: However, you would first need a known sample of fresh giant squid with which to compare it.

Saila: You could use a process of elimination and remove the objects which it could be.

Walford: Is the blackline tilefish different from the one in the North Atlantic Ocean?

Starck: We have both species here. The blackline tilefish is smaller and very common here, while the northern tilefish which has the high crest is also here but less common.

Walford: What depth and temperature is the northern tilefish found here?

Starck: At about 100 fathoms in very cold water, although I do not know the exact temperature. We catch a few tilefish here, and only two northern tilefish have been taken there by us, although several other people have taken a number of them, perhaps a dozen.

Gruber: Recently many northern tilefish have been taken off Miami in deep waters by charter boatmen. They catch numbers of these using new deep-fishing methods.

Starck: Perhaps they do catch more off Pier 5, Miami than they do off the "hump."

Luke Gorham: A black rudderfish was recently taken weighing 21 or 22 pounds off Miami. Isn't this rather large and rare for this area?

Starck: This is the first time this species has been taken south of Cape Hatteras.

Meyer: Are there any bluefin tuna found in deep water here?

Starck: No one has fished for them, but you can catch little ones on the surface in the stream in the summer.

Meyer: What information is there on the migratory habits of the bluefin tuna that were tagged here and were taken in Norway? What about the rest of the journey; do they make a circle?

Mather: We thought that the theory on north-south migrations on the two sides of the Atlantic fitted very well with timetables and where and when they could be caught, but since 50 per cent of our tuna tags are from Europe, I must reconsider that idea. However, the difference is partly due to the much greater intensity of tuna fishing in Europe. I would like to ask if there is any seasonality in the occurrence of amberjack and almaco jack?

Starck: The great amberjack are on the reefs in the winter, but not there in the summer. Generally, we fish mostly on the "hump" in the summer, although the "hump" may have a permanent population. The population on the reef does go somewhere in the summer, and possibly that is where it goes.

Dell Parkinson: Is fishing with a light a simple rig, and do you have to worry about being electrocuted?

Starck: No. If it short circuits, it will burn out the light bulb or blow a fuse. It is simply a light bulb in a sealed glass jar.

Parkinson: During the summertime we have many fish coming to our amber-colored lights on the dock. Does the amber light attract fish to our amber lights more than a dock which has white lights?

Starck: The Japanese have done a lot of work with nightlighting. They have a fishery which uses night lights, and have done experiments with different colored lights. I do not know the exact results, but they have found that some lights are more effective than others for certain types of fish.

Bullis: Fish show a definite reaction to different colored lights. We did some experiments about five years ago using amber, white, red, green, and blue lights. We found that there was a certain period of time, about fifteen or twenty minutes, before we started obtaining a set of reactions from the fish. The fish would not react if the different colored lights were merely flashed on and off, but it was necessary to leave the light on fifteen or twenty minutes and then change the color. Very frequently, fish which had gathered under the lights completely changed the species composition and figuration, and we had one interesting reaction. We had a bright white light under the water and turned a red light on. All the fish disappeared, but after about twenty or thirty seconds about two to three hundred very large squid came charging in at the light and approached it in a matter of a few feet, then slowly disappeared. We were able to repeat this every half hour or so and get the same reaction.

Parkinson: How deep was this light?

Bullis: It was about one or two feet under the surface.

Charles C. G. Chaplin: Are electric reels standard equipment, or are they made up specially?

Smith: Most of these electric reels are unreliable and expensive. It might be possible to buy standard reels to put on any boat, although they usually burn out too easily. All of those seen so far are specially designed. We can provide you with the specifications of the reels used on our boat.

Starck: The Pacific halibut fishery uses electric reels for deep trolling for salmon, using steel cable and electric power. These reels are manufactured commercially.

ECOLOGY OF EGGS, LARVAE AND YOUNG OF GAME FISHES IN THE CHESAPEAKE BAY

Romeo J. Mansueti

Bill Meyer: Has the population of striped bass decreased, and is it increasing now?

Mansueti: I will cover this tomorrow during the Gulf and Caribbean Fisheries Institute. I might say now that the populations have grown tremendously, and we have had some excellent dominant year classes. The frequency of dominant year classes and their magnitude are increasing in the Chesapeake Bay area.

Meyer: Does the population at Chesapeake migrate along the coast northward and southward?

Mansueti: Evidence indicates they move largely northward, and this movement is largely restricted to fish greater than five pounds. Most pan-size fish (in Chesapeake Bay these are 12 to 20 inches) seldom leave the general tributary where they are tagged. We think there is a relationship between the occurrence of two-year-old fish (12 inches) and the spawning area. They stay there two or three years in the rivers where we do the tagging such as the Potomac and James rivers, and the upper Bay. The migrants are the big ones.

Unidentified speaker: There is a great migration of striped bass in Hatteras in the surf in December; are they from Chesapeake or Massachusetts or where?

Mansueti: James Sykes of the U. S. Fish and Wildlife Service has showed through tagging that these go to Chesapeake Bay and also to Massachusetts as far north as Nova Scotia. We don't know if they come back to North Carolina. We think that the "jumbos" off New England come back to Chesapeake Bay, perhaps every three to five or eight years and spawn. We don't think they spawn up there; most of the "jumbos" are females.

Unidentified speaker: The bull striper is a big female. Is it true that the males don't get over five pounds?

Mansueti: We have records of males to 28 pounds. However, any male over 12 pounds is unusual. There may be sex reversal in the striped bass as in other sea basses. This is opposite from the condition in the black sea bass.

Unidentified speaker: Stripers do not take a lure or bait at this time. Why is this so?

Mansueti: I don't know. In Maryland the big "jumbos" hit during the same month, but in the estuaries. A Virginia Beach surf fishery is developing, and maybe there is potential along Chincoteague, as there is in North Carolina, Virginia Beach, and New Jersey.

Arthur Marshall: Could you briefly describe the role of wetlands development and mechanisms operating to produce populations?

Mansueti: The big change occurring now is the filling of wetlands of the Eastern Shore of Maryland with the object toward land development. This filling results in the destruction of tremendous areas of marshlands which is usually described by Odum's paper regarding the value of marshlands in estuarine ecology. This area produces much fertilization of materials, but accentuates the growth of phytoplankton which produces a very rich soup in Chesapeake Bay tributaries on which small fishes and shrimps and other organisms feed. The second use of these wetlands is that of dumps for great quantities of pollutants from cities which are using up the marshland. The explosive population development where towns are taking over areas spacewise is becoming quite a problem. I refer you to Dr. Charles Renn's paper, from Johns Hopkins University, in which he describes the insidious effect of man upon marshes, and points out that eventually man's predilection for the coastal area and his insatiable desire to stay in the area will result in eventual loss of most of our wetlands.

Marshall: Are you referring to the upper reaches of the tributaries or the development in estuaries?

Mansueti: I refer primarily to the eastern shore of Maryland which is a typical coastal plain with a dendritic pattern with large tributaries such as the Choptank, Sassafras, Nanticoke, and Wicomico rivers. All of these are very important tributaries as spawning and nursery grounds for fishes. Many people are coming here to retire.

Marshall: Forthcoming missile developments in the Cape Canaveral area, with reference to federal construction in the St. Johns River project, may remove half of the head-water marshes from the actual flood basin of rivers through levee construction. An example is the St. Johns River with broad sawgrass marshes. There is perhaps one or two hundred miles involved here.

Mansueti: I refer you to Dr. Robert Harrington's work on tarpon in which he showed that the principal nursery areas for tarpon are the marshes. I believe the real importance involved the food chain of animals such as crustaceans and zooplankters as food for young fishes which are susceptible to toxic materials. The real problem is the loss of space or area of potential that is the reduced carrying capacity.

Marshall: Can you describe the material which enters the estuary and flocculates at the salt water interface? Is this plant detritus?

Mansueti: This is a combination of inert inorganic, organic, and mostly silt, as well as any runoff material, both natural agricultural and domestic and industrial.

Swartz: One of the top species in the southern Atlantic and Gulf areas is the spotted seatrout. Durbin Tabb's studies show the relationship of the grassy areas to the seatrout. These areas are being destroyed by dredging, filling, and real estate development.

Smith: Thank you for a most interesting discussion. Are there any other questions involving the meeting?

Mansueti: I would like to ask Mr. Benedict in his paper earlier this morning if he can summarize and recommend how we can best cement relationships between scientists and sportsmen.

Benedict: Although this is hard to answer, I think the problem lies in mutual communication. There are many anglers eager to abet scientific investigations, and many areas of scientific investigations eager to enlist support of the anglers. We must get these people together, and this is what is being done here.

- - - -

THE INTERNATIONAL OCEANOGRAPHIC FOUNDATION
COOPERATIVE RESEARCH COMMITTEE

Donald P. de Sylva
Chairman

The International Oceanographic Foundation, at the International Game Fish Conference last November, initiated the Cocperative Research Committee to investigate the problems of organizing and developing cooperation between non-professionals and scientists in marine research. Although cooperative research of this kind has been carried out by various research institutes in the past and frequently through the services of the Foundation, this Committee has been formed because of the increasing number of anglers, boatowners, skindivers, and others who enjoy the water world and the secrets of "inner space" and who wish to help marine scientists obtain information about the oceans. Many persons not trained in marine science are keen observers possessing a knowledge of the ways of the sea from their long experience in and on it. The numerous problems of the sea and the lack of adequate numbers of trained marine scientists require cooperative efforts in collecting data and making observations for specific studies over the expanses of the ocean. The aid of many persons will make the task of the professional marine scientist an easier one. But the scientist is not always prepared to use the assistance of angler or yachtsman when offered to him, and the angler is not always aware of whom to approach in the science world.

The purpose of the Committee is to act as a clearing house between scientists, who need the help of ships and men in collecting data or specimens for their research, and the amateur oceanographers who would like to assist them. The Committee maintains a list of persons who write to the Foundation offering such assistance, as well as a list of scientists seeking assistance on specific projects. Thus, for example, an angler who intends to spend two weeks off the coast of Venezuela might conveniently collect, preserve, and ship water samples to a scientist living in Germany who is studying microscopic plants from tropic waters of the oceans. Or an American scientist might wish to examine the pectoral fin from several species of marlins from Tahiti. This Committee would facilitate matters by putting the angler or boatsman in touch with the scientist.

Anglers and boatmen have cooperated with marine scientists for many years. At The Marine Laboratory of the University of Miami, for example, cooperation began in the early 1950's, when anglers of the Palm Beach Sailfish Club began tagging large numbers of sailfish off the Florida coast. This work is being continued by Woods Hole Oceanographic Institution, and now many anglers readily tag and release tuna, marlin, sailfish, and amberjack in hopes of discovering their migration routes. Cooperation has also been given at various times by anglers who assisted scientists at the Miami laboratory by tagging mullet, sea trout, tarpon, spiny lobster, and shrimp.

In 1954, the U. S. Power Boat Squadrons assisted red tide studies by The Marine Laboratory by dropping thousands of colored drift cards sealed in plastic envelopes. These were scattered simultaneously at predetermined points along the west coast of Florida, and water samples were taken simultaneously for subsequent determination of the salt content of the water. The drift cards were collected several days later by a similar flotilla and then drift patterns calculated. The results showed the patterns of current and eddies in the eastern Gulf of Mexico. This was important in predicting movements of red tides along the beaches. No research laboratory has the staff, boats, or funds to conduct a huge experiment over such vast waters, and the help of the Power Squadron made the study a success and the first of its kind on such a scale.

The U. S. Coast Guard has assisted scientists at the University of Delaware by permitting them to accompany them on cruises for studies on hydrography and plankton, and on artificial reefs. In Miami, counts of fishing boats in Biscayne Bay were made possible through the use of a Coast Guard helicopter.

Officers and crews of ships at sea may make valuable observations for scientists. In the United Kingdom, the Meteorological Office sponsors a voluntary observing fleet and ocean weather ships which make thousands of regular, detailed observations on weather at sea. These data are analyzed by scientists and in turn are of great value to the ships. Sea-surface currents, temperatures, winds and waves, cloud formations, and any unusual phenomena are regularly reported. Commercial vessels are also used in various parts of the world, and particularly in Europe and Japan, to record hydrographic data which are important in locating, interpreting, and forecasting fisheries areas. Some vessels in the United Kingdom are outfitted with the Hardy Plankton Sampler, a special net which takes and preserves continuous samples of the plankton during a cruise. Such data are invaluable to the fishing industry. Based upon these observations, atlases of currents and data on winds, waves, and weather, and fishing conditions can be published and made available immediately to all mariners.

Woods Hole Oceanographic Institution presently prepares and distributes information on the Bermuda Ocean Race to participants, who in turn collected temperature data for the Institute. Data such as this could be collected through the cooperation of anglers and yachtsmen in many areas, and in turn be analyzed and presented as useful current forecasts. The International Oceanographic Foundation also prepares a brochure, "Hints for Sailors," which includes forecasts for the Miami-Nassau Race annually. Data for this are also collected by anglers and yachtsmen.

Specimens are donated also. Florida anglers have provided innumerable fishes for study, including sailfish, barracuda, amberjack, marlin, spearfish, bluefish, mackerel, tarpon, and red drum, as well as many rare or even new species. The scientist is provided with far more specimens than he or his laboratory could have obtained with dozens of employees all casting furiously. Such cooperation is common all over the country.

In most of our states, anglers regularly assist the scientists in creel-census studies, in which anglers are requested to report by post card or by questionnaire on the day's fishing success, the bait used, and the time spent in fishing. And in California and New Jersey, organized skin divers have helped scientists by counting the number of fish in a given area, and New York divers have attempted to rid the predatory starfish from oyster beds. Censuses are now being continued by the American Littoral Society under the direction of Mr. John R. Clark, U. S. Fish and Wildlife Service. This group organizes voluntary skin divers along the coast who can conduct fish counts in various areas on each of several days a year, similar to the Christmas bird counts of the National Audubon Society.

In Hawaii, a cooperative effort was instigated by the Division of Fish and Game and local sportsmen and citizens. Angered by a series of shark attacks ending with the death of a young swimmer, they organized the Billy Weaver Shark Control Program, named after the latest victim. A considerate effort was made to kill off the sharks, using commercial longline gear with many hooks, over a year's period. A great number of sharks were taken, resulting not only in the reduction of the number of sharks in the area, at least for a short period, but also in the accumulation of a great deal of biological data on food habits, growth, migrations, and reproduction of sharks. Such data are fundamental if we are to learn how to cope with the shark menace.

Anglers and yachtsmen have assisted directly by collecting specimens for scientists at Ocean City, Maryland, the Bahamas, and Florida. Many guides have examined stomach contents or have made plankton tows, and preserved the specimens for study. And these persons are always quite willing to have scientists accompany them on their vessels to make observations and collections at sea, at no cost to the scientist or to his institution. Joe Reese, taxidermist at Fort Lauderdale, has been saving rare fishes or specimens, such as young sailfish, for many years from the stomachs of the fish he receives for mounting. He has also saved the scales of many large barracuda for age determination. Al Pflueger, taxidermist in North Miami, has also preserved for scientists to study, new or rare species of fishes, including a new species of the marlin family. He has also made data available for growth studies on sailfish.

Ships are often made available to scientists by anglers. Woods Hole Oceanographic Institution is able to carry out detailed research into the migrations of tuna and marlin through the efforts of Mr. Lou Marron, a renowned sportsman and holder of the world record, 1,182-pound swordfish, who donated his vessel, Eugenie VIII, to Woods Hole for gamefish research. Mr. Otis Smith, operator of a large menhaden fleet, placed his research vessel, Cape May, at the disposal of the U. S. Fish and Wildlife Service for exploratory shark fishing and hydrographic studies off the New Jersey coast. The late Mr. Eric Heckett, industrialist and inventor, placed his vessel Heckmere, at the disposal of The Marine Laboratory for seven months each year, which permitted offshore plankton, diving, and trawling operations in Florida and the Bahamas. Mr. Carl Shirley, of New Jersey, will donate the use of his vessel Firebird for use in the Bahamas by The Marine Laboratory next summer.

Anglers and yachtsmen have been able to support research directly. Mr. Alfred C. Glassell, Jr., oil industrialist from Houston and a member of the Board of Trustees of the Foundation, supported and accompanied an extensive marine biological expedition to the Indian Ocean in cooperation with Yale University, and more recently to Ecuador, Columbia, and Panama in cooperation with The Marine Laboratory of the University of Miami. Mr. Lou Marron supported expeditions at the University of Miami to Chile, Perú, and Ecuador from 1954 to 1956, permitting extensive information to be gathered on the currents in that area, and on the life histories of swordfish and marlin. Mr. and Mrs. John A. Manning presently of Coral Gables, personally carried out exploratory fishing with The University of Miami using commercial longline gear off Chile to assist the government of Chile in developing its natural sources, and in supplying the Chilean scientists with valuable data on their resources. Mr. Robert F. Maytag, of Scottsdale, Arizona, personally led and financed a four-month expedition to Africa to collect birds, mammals, and fishes for the University of Miami Zoology Department. Mr. Edwin J. Gould, of New York and Bermuda, supported and led an expedition to New Zealand in search of information on the biology and systematics of marlin.

Unusual cases of assistance are exemplified in the altruism of Mr. Michael Lerner in establishing the Lerner Marine Laboratory of the American Museum of Natural History, at Bimini, Bahamas, where hundreds of studies have been carried out by scientists from all over the world. The late Mr. George Vanderbilt founded and funded one of the finest collections of marine fishes ever assembled. Similarly, Foundation member Mr. Charles C. G. Chaplin, yachtsman and sportsman of Philadelphia, established the Chaplin Chair of Ichthyology at the Academy of Natural Sciences of Philadelphia, permitting extensive collections and research on fishes to be expanded. Mr. Maytag has also established a similar chair at The University of Miami, permitting research expansion and fellowships for deserving graduate students. Other members, too numerous to enumerate here, have given fellowships for students through The International Oceanographic Foundation. One in particular provides fellowships for graduate studies for the sons of charter boatsmen, anglers, and commercial fishermen.

In some instances, expensive but necessary equipment is donated, such as vessels, skiffs, motors, diving gear, and commercial fishing gear. The Sport Fishing Institute of Washington, D. C., has provided motors enabling collections of larval fishes to be made in Delaware. This Institute has provided, through the generosity of tackle and boating manufacturers, numerous fellowships and equipment grants to a score of universities and institutions throughout the United States.

These are but a few of the ways in which anglers, yachtsmen, and others have cooperated with scientists for the mutual solution of problems. The ways in which such groups can aid science are limited only by man's imagination. In most instances, the benefits of such cooperation are not only of interest to the angler or boatman but actually can result in direct and immediate dividends.

The International Oceanographic Foundation's Committee assists scientists in carrying out their research by placing them in contact with anglers, yachtsmen, and others willing and able to assist along the lines mentioned above, and will encourage new avenues of cooperative effort. A list of individuals who are being asked to serve on the Committee is appended. These Committee members are being asked to contact scientists, anglers, yachtsmen, and others who can make use of the Committee. Data on specific projects, names of persons or clubs cooperating, availability of vessels and their facilities, possible cruise patterns, and other pertinent information will be put on punch cards for ready sorting. In this way, after sufficient data are accumulated, it will be possible to place scientists and anglers and others in immediate touch.

Some of the projects being considered by the Committee include a program of organized shark killing by anglers prior to fishing tournaments, and in areas where sharks are a menace to anglers and bathers. Such a program, especially if coordinated with biological studies, could reduce the potential danger of sharks and could add immeasurably to our knowledge of shark biology. Shark tagging could also be one phase of this program which would supply definite information on migration, age, and growth of sharks.

Another aspect which the Committee has planned includes the designs of special kits for various types of data and specimen collecting and tagging. Anglers and yachtsmen wishing to take active part in research could have available to them, as part of the kit, thermometers, inexpensive hydrometers for salt analysis, drift cards for current studies, plankton and dip nets for collecting fishes, waterproof night-lights, and preservatives, together with a brochure of instructions. The contents of the kit would depend upon the scientists' and anglers' mutual wishes.

The Committee may be able to arrange for short anglers' or yachtsmen's seminars prior to tournaments and races or club meetings, informing them of recent scientific activities of direct interest to them and giving brief instructions. In this way, a maximum amount of anglers and yachtsmen can be contacted directly and informally. The Committee would also present specialized discussions and literature on estimates of current speed such as has been offered in The University of Miami's "Hints for Sailors".

It is the Committee's aim to encourage research on the oceans by as many persons who desire to contribute their time and energy, and to solve problems of importance to all of us. This can also be implemented by encouraging fellowships for sons and daughters of anglers, charter boatmen, and yachtsmen in permitting them to channel their love of the sea into a professional career in oceanography. The Committee may also encourage and recognize outstanding contributions to science by the angler by making recommendations to The International Oceanographic Foundation for its Gold Medal Angler Award, presented annually at the International Game Fish Conference. Other specialized awards for outstanding services to marine sciences may be considered.

Persons interested in assisting marine scientists by making their time available, or by assisting through other means, are cordially invited to add their name to the growing cross-indexed card file by writing to the Chairman, Cooperative Research Committee, International Oceanographical Foundation, Rickenbacker Causeway, Miami 49, Florida. Cooperating individuals should state their desire to assist and outline available facilities and desires in as much detail as possible. Similarly, marine scientists from all over the world who need specific information, data, or specimens from various localities may contact the secretary for further information and for inclusion of their names on the Committee's list.

Persons Requested to Serve on the

INTERNATIONAL OCEANOGRAPHIC FOUNDATION COOPERATIVE RESEARCH COMMITTEE

Senor Pablo Bardin y Sra
Defensa 1220
Buenos Aires, Arentina
S. A.

Mr. George A. Bass
Bass Engineering & Const. Company
Birmingham Theatre Building
Birmingham, Michigan

Carlos Behrens
Apartado #62
Caracas, Venezuela

Mr. Nelson Benedict
Outdoor Editor
Newark Star-Ledger
Newark, N. J.

Mr. John H. Bethell
Post Office Box 478
Nassau, Bahamas

Mr. Esteban A. Bird
Banco Credito y Ahorro Ponceno
San Juan, Puerto Rico

Mr. D. H. Braman
408 Victoria Bank & Trust Building
Victoria, Texas

Mr. William K. Carpenter
9462 Nemours Building
Wilmington 98, Delaware

Mr. John R. Clark
U. S. Fish & Wildlife Service
Bureau of Sport Fisheries & Wildlife
Sandy Hook Marine Laboratory
Atlantic Highlands, N. J.

Mr. Edward S. Corlett III
Industrial Bank Building
25 West Flagler Street
Miami, Fla.

Mrs. Dorothea Lincoln Dean
243 Ocean Terrace
Box 1087
Palm Beach, Florida

Dr. Donald P. de Sylva
1815 Wakeena Drive
Coconut Grove, Fla.

Mr. William H. Doheny
136 El Camino
Beverly Hills, California

Mr. Victor Dunaway
Fishing Editor
Miami Herald
Miami, Fla.

Senor Luis Fernández de Gamboa y Segurola
Arenal 4
Madrid, Spain

Mr. Allison Fleitas
1100 North Lake Way
Palm Beach, Fla.

Mr. Edward W. Gorham
3901 Alhambra Court
Coral Gables, Fla.

Mr. Elwood K. Harry
1614 Broad Street
Bloomfield, N. J.

Dr. IImo Hela
Merentutkimuslaitos
Inst. of Marine Research
Tahtitorninkatu 2
Helsinki, Finland

Col. John K. Howard
330 Fernwood Road
Key Biscayne
Miami 49, Fla.

Dr. Robert J. Hurley
3687 Avocado Ave.
Miami 33, Fla.

Mr. Robert M. Ingle
Director of Research
Florida State Board of Conservation
W. V. Knott Building
Tallahassee, Fla.

IOF Cooperative Research Committee - continued

Mr. Charles F. Johnson
369 South Lake Drive
Palm Beach, Fla.

Mr. J. Seward Johnson
Johnson & Johnson
New Brunswick, N. J.

Mr. Henry Lyman, Editor
Salt Water Sportsman Magazine
157 Federal Street
Boston 10, Mass.

Mr. Ernest Lyons
The Stuart News
111 E. Ocean Blvd.
Stuart, Fla.

Mr. Finn H. Magnus
Washington Valley Road
Morristown, N. J.

Mr. John A. Manning
740 Valencia Avenue
Coral Gables, Fla.

Dr. Romeo Mansueti
Chief Fishery Biologist
Natural Resources Institute
University of Maryland
Solomons, Maryland

Mr. Louis E. Marron
744 Broad Street
Newark 2, N. J.

Mr. Frank J. Mather III
Woods Hole Oceanographic Institution
Woods Hole, Mass.

Dr. Robert F. Maytag
Arizona Zoological Society
234 South Ball Park Plaza
Scottsdale, Arizona

Mr. Howard Modavis, Outdoor Editor
Miami Daily News
1001 N. W. 7th Street
Miami, Fla.

Capt. Frank T. Moss
West Lake Drive
Montauk, N. Y.

Mr. Don McCarthy
Nassau Development Board
P. O. Box 818
Nassau, Bahamas
B.W.I.

Count Warner Morner
Koniginstrasse 37
München, Germany

Mr. Enrique Pardo
P. O. Box 595
Lima, Peru

Mr. Peter Perinchief
Poseidon
Tamarind Vale
Warwick, Bermuda

Dr. Gilberto Pesquera
Biology Department
University of Puerto Rico
San Juan, Puerto Rico

Mr. Al Pflueger
P. O. Box 1328
North Miami, Fla.

Mr. Eduardo Reyes C.
Casilla 192
Santiago, Chile, S. A.

Mr. Critchell Rimington
Yachting
205 East 42nd Street
New York 17, New York

Mr. John D. Ritchey
1800 S. E. 7th Street
Fort Lauderdale, Fla.

Mr. James B. Robertson
Post Office Box 513
Nassau, Bahamas

IOF Cooperative Research Committee - continued

Mr. Erl Roman
6825 Veronese Street
Coral Gables, Fla.

Dr. Orris S. Russell
Director of Agriculture
Agricultural & Marine Products Board
Nassau, Bahamas

Mr. John Rybovich
John Rybovich & Sons Boat Works
4200 N. Dixie Highway
West Palm Beach, Fla.

Mr. Richard H. Stroud
Executive Vice-President
Sport Fishing Institute
Bond Building
Washington 5, D. C.

Mr. & Mrs. Leland R. Taylor
1744 Reedvale Lane
Mandeville Canyon
Los Angeles 49, California

Mr. George C. Thomas
10905 Winnetka Street
Chatsworth, California

Mr. Charles Dabney Thomson
8615 Indian Hill Road
Cincinnati 43, Ohio

Mr. A. W. G. van der Riet
Cathedral Peak Hotel
Winterton
Natal, South Africa

Mr. Bill Wisner
Post Office Building
20 Whitehouse Avenue
Roosevelt, L.I., N. Y.

Mr. Philip Wylie
7450 S. W. 47th Court
South Miami 43, Fla.

Program

REEF-FISH SYMPOSIUM

Sponsored Jointly by the Gulf and Caribbean Fisheries Institute
and the International Game Fish Conference

Tuesday, November 14, 1961

Carillon Hotel, Miami Beach

1:00 P.M.

	Moderator:	John E. Bardach University of Michigan
1.	Introduction (20 minutes)	John E. Bardach
2.	Food and feeding habits of reef-fishes	John E. Randall University of Puerto Rico
3.	Reproductive behavior of reef-fishes	Howard E. Winn University of Maryland
4.	Territoriality in reef-fishes	C. Richard Robins University of Miami
5.	Coral reefs and conservation	Othello L. Wallis U. S. National Park Service